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Influence of N-Fertilizer application on the yield and yield components of two varieties of eggplant (*Solanum melongena* L.) In Anyigba, Kogi State

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Abstract

There is a need to device a possible ways of improving necessary nutrients for better performance of eggplants. The use of mineral fertilizer in tropical soils can help solve the problem of low soil nutrients. So far, only N-level have been recommended in most of the region of Nigeria, the specific requirement for varieties have not or in most cases been overlooked, therefore determination of the interaction of N-level with variety is necessary as it will enable researchers determine specific level of N-fertilizer for specific variety. Thus research was conducted on Kogi State University Student Research and Demonstration Farm (Longitude 07°06[1] N; 43°E), Anyigba, Kogi State, to investigate the influence of N-fertilizer on the yield and yield components of eggplant (*Solanum melongena* L.) the experiment consisted of two varieties of eggplants green variety encoded as NC-2, the Off-white variety encoded as NC-1 and three urea fertilizer levels (0, 100, 200kgN/ha). Factorial combination of the treatments gave a total of six treatments which was laid in a Randomized Completed Block Design (RCBD) with four replications. Urea fertilizer was applied in 2-split doses first at 3weeks after planting and the second dose was applied at fruiting. Parameters measured include: plant height, number of leaves, stem girth, fruit diameter, number of nodes, number of branches, number of fruits per plant, number of flowers per plant, fruit weight. Fertilizer application significantly increased the yield of the two varieties. However, NC-2 (green variety) appears to respond more to higher N-application (up to 200kgN/ha) as compared to NC-1 (off-white variety). Also, fertilizer had significant effect on vegetative characters, yield and some yield components. The yield were found to be statistically at par.
Key words: Eggplant, Number of branches, Number of fruits, Fruit diameter, Fruit yield, number of flowers, number of nodes, number of leaves, plant height.

INTRODUCTION

Background to the study

Eggplant (*Solanum melongena* L.) is an economically important vegetable crop across many countries in Asia and Africa (Collonnier *et al.,* 2003). In Nigeria, it has been reported that little attention is paid to traditional vegetables which have high nutritive value like eggplant (Okezie and Okoye, 2006). Eggplant is a long duration crop with high yield which removes large quantities of nutrients from the soil (Hedge, 1997). The crop is widely cultivated across most of the African continent and more intensively in west and east Africa. It's consumed almost on a daily basis by urban families and also represents the main source of income for producing households in the forest zone of West Africa (Danquah-jones, 2000). Eggplant is a long duration crop with high yield which removes large quantities of nutrients from the soil (Hedge, 1997). The crop is widely cultivated across most of the African continent and more intensively in west and east Africa. It's consumed almost on a daily basis by urban families and also represents the main source of income for producing households in the forest zone of West Africa (Danquah-jones, 2000). In West Africa, the eggfruits are eaten raw, cooked or fried with spices in stews, or dried and pound as condiments (AVRDC, 2008). Nitrogen and phosphorus are the usually most limiting nutrients elements in most soils in Africa and are often simultaneously deficient (Suge *et al.,* 2011). Applied N is taken up by the crop in the field or immobilized in soil organic N pools, which is vulnerable to losses from volatilization, de-nitrification, and leaching (Cassman, 2002). Studies have shown that leaving the ground bare between fall and spring cropping periods increases the risk of nutrients leaching into ground water. Nitrate nitrogen is among the most significant nutrients lost through this process due to greater solubility (Li and Reddy 1997). Eggplant production in Nigeria is constrained by the low level of soil fertility, coupled with poor prevailing climatic conditions and this result in low yield of the plant. Constraints and the problem of soil nutrients of low to medium level of available nutrients have caused yield below potential levels

(Adepetu, 1986). The best way of preventing soil from becoming poor is to put back into it what plant has taken out and this can only be achieved by the use of inorganic fertilizer (Roberts and Andrew, 1989). Given the relatively low N-level relative to other macronutrient (P&K) in Anyigba environment, there is the urgent need to find the optimum level of N- required for specific variety of eggplant in Anyigba environment.

The objectives of the study are therefore to determine the:

1. Influence of N-fertilizer application on the yield and the yield components of the two varieties of eggplant in Anyigba kogi state.
2. Influence of N-fertilizer application on the growth of the two varieties of eggplants.
3. Interactions between N-fertilizer application and variety of eggplant in Anyigba environment.

MATERIALS AND METHOD

Location of the experiment

The experiment was conducted at Kogi State University Student Research and Demonstration Farm (Lat 7^o 29^1 and Long 70 11^{1}E) in the Guinea savanna agro ecological zone during the rainy season of 2014. Kogi state has a bimodal rainfall with the peak pattern occurring in July and September. The temperature shows some variation throughout the years. Average monthly temperature varies from 17^{0}C to 36.2^{0}C. Relative humidity is moderately high and varies from an average of 65-85% throughout the year (Amhakhian *et al*., 2012).

Treatments and experimental design.

The treatments consisted of varieties NC-1 (off-white) and NC-2 (green) encoded as (V_1 and V_2) and Urea fertilizer levels 0, 100, 200kg N/ha encoded as F_0, F_1 and F_2 combined in all possible ways (Factorial combination) to obtain a total of six (6) treatment combinations as V_1 F_0 (Control), V_1 $F_{1,}$ V_1 $F_{2,}$ V_2 F_0 (Control) V_2 F_1, V_2 $F_{2.}$

Soil analysis

Soil samples were collected from six locations on the experimental site at a depth range of 0-30 cm. It was then mixed thoroughly to form a composite sample which was analyzed to determine its physical and chemical properties. Results are summarized in Table 1.

Land preparation

The lands used as nursery and experimental plot were cleared mechanically, ploughed, harrowed and a flat seed bed was raised for the nursery and experimental plot.

Cultural practices

Raising seedlings in the nursery

A flat bed of dimension of 1.0m × 1.5m was prepared on 16th June, 2014 for raising the seedlings. Seeds were drilled on the bed near water source the following day, after which a thin layer of soil was used to cover the bed followed by frequent watering and weeding to prevent competition with the seedlings.

Transplanting of the eggplant varieties

Seedlings were transplanted on 8th July, 2014., when they attained a height of 10-12cm with 4-6 leaves to the experimental field with the two varieties to all the plots at a spacing of 70 × 75cm with plant population of about 20plants per plot.

Weeding

Weeding was done manually by regular hoeing at 3weeks interval throughout the experiment.

Fertilizer Application and Calculation

Fertilizer (Urea) was applied in 2-split doses at 0, 100, 200kgN/ha. First dose was applied at 3weeks after Transplanting and the second dose was applied at fruiting.

Harvesting

Harvesting was done by clipping the fruits from the plant above the calyx. This was done separately per plot and labelled for ease of identification.

Data collection and analysis
For the various growth characters studied, three plants were randomly selected and tagged from the discard rows. All measurements were taken and averaged over three plants.

Plant height
This was determined by measuring the height attained at transplant, 3, 6 and 9 weeks respectively after transplanting. The height from the ground to the tip of the plant was measured using the meter rule.

Number of branches
The number of branches of fruiting plants was counted per plant in each plot at 6 and 9WAT.

Number of leaves per plant
The total number of leaves produced by the three tagged plants were counted manually and averaged at 3, 6 and 9WAT.

Number of nodes
The numbers of nodes of fruiting plants was counted per plant in each plot at 9weeks after transplanting.

Fruit diameter
The diameter of fruits harvested from each plot was measured using a venier calliper.

Stem diameter
The diameter of each stem was measured per plot with a Vernier calliper at 6 and 9WAT.

Number of flowers per plant
The number of flowers per plant was counted in each plot at harvest.

Number of fruits per plant
The numbers of fruits borne on each plant was counted in each plot and this was also done at harvest.

Fruit weight
The various fruits harvest from the net plot was finally pulled to determine the total fruit weight per plot.

Fruit yield/ha
The fruit yield per hectare was determined by extrapolating the fruit yield per net plot.

$$\text{Yield/ha} = \frac{\text{Fruit Weight}}{\text{Land Area}} \times 10{,}000$$

Statistical analysis
The growth and yield parameters collected were collated and subjected to analysis of variance (ANOVA) to evaluate the influence of N-urea on two varieties of eggplants Significantly, means difference were separated using Fishers Least significant test (F-LSD) test at 5% level of probability (Little and hills, 1978).

RESULT AND DISCUSSION

Soil analysis
The result of the soil analysis in table 1 shows that the soil belongs to a textural class of sandy-loam and low in total nitrogen relative to available phosphorus with a pH of 7.3 which is slightly alkaline.

Effect of fertilizer on the growth and yield characters.
Results from the study (Table 2) shows that fertilizer had significant effect on the numbers of leaves. Plant with the highest numbers of leaves was consistently obtained when 200kgN/ha of fertilizer was applied However the effect of variety on the numbers of leaves was not significant, ($p \geq 0.05$). Plant height was significantly influenced by fertilizer also, 200kgN/ha of fertilizer produced the tallest height. Control plots gave the shortest height However, height as influenced by variety and interaction was not significantly different ($p \geq 0.05$) for all the sampling periods. Increase in plant height with increasing level of fertilizer application, have been reported in Bar *et al.* (2001), Prabhu *et al.* (2003) and Wange and Kale (2004) and Ge *et al.* (2008) findings where they observed that Nitrogen application increased plant height at vegetative, flowering and reproductive stages. Stem

girth was found to be significantly influenced by fertilizer the highest girths (22.31cm) was obtained when 200kgN/ha of fertilizer was applied, followed by 100kgN/ha application which were both higher than the control. Plant girth significantly varied with variety ($p \leq 0.05$) NC-2 significantly produced thicker stems (30.39cm) than NC-1 (27.07cm). Fertilizer had effect on branches and nodes (table 3). The highest numbers of branches and nodes were obtained when 200kgN/ha of fertilizer was applied, for all the sampling stages. However, the highest numbers of flowers (37.07) was obtained when 100kgN/ha of fertilizer was applied and this was significantly higher ($P \leq 0.05$) than the 200kgN/ha application. The response of flowers to nitrogen fertilizer application above 100kgN/ha may be attributed to the fact that there is luxury consumption of nitrogen resulting in excessive vegetative growth at the expense of maturity thereby delaying maturity, also increase in number of leaves with period of harvest may be due to the fact that plant that produce more leaves would have increased photosynthetic area (i.e. absorbed more Photosynthate) and hence better performance in terms of yield. The control plots gave the least numbers of flowers (table 3). Number of branches and flowers produced significantly varied with variety ($p \leq 0.05$). NC-1 significantly produced higher number of branches and flowers (34.82) than NC-2; however NC-2 significantly produced higher number of nodes (139.51) than NC-1. The interaction of variety and fertilizer was significant for these three characters measured. Tables 4, 5 and 6 shows the interaction of variety and fertilizer on some characters measured.

Nitrogen fertilizer significantly influences yield and yield characters. Number of fruits per plant increased significantly with increasing nitrogen level. This result conforms with Pal *et al.* (2002) who reported that eggplant fruit yield increased with increase in N up to 187.5 kg N ha^{-1}, Mohammad *et al.,* (2010) findings where Nitrogen is found to promotes growth and increases biomass production, and nitrogen fertilization has been used to increase growth and yield of eggplant Also, Devi *et al.* (2002) found better fruit girth, fruit weight and fruit yield level of eggplant with the application of 120 kg per hectare. In excess, nitrogen may have adverse effects on the vitality of plants. Extra nitrogen fertilizers cause changes in the shoot/root ratio and reduce mycorrhizal induction in soil. The reduced activity of roots can create a nutrient imbalance. However nitrogen had no significant effect on fruit diameter, this may be attributed to the fact that both varieties are improved, and may be closely related in their genetic composition.

Effect of variety on growth and yield components

Variety had no significant effect on some of the growth characters such as number of leaves, height of plant, fruit diameter, number of fruits per plant and the yield in general. This observations may be attributed to the fact that both varieties are improved, therefore they could be closely related in terms of genetic composition and have same potential for yield.

However variety had significant effect on number of branches, number of nodes, and number of flowers (table 3). NC-1 performs better than NC-2 in terms of number of branches and flowers produced while NC-2 performs better in terms of number of nodes. This observation may be due to varietal differences.

There was no significant influence on the two varieties of eggplant examined. This may be due to the fact that both varieties have high potentials for photosynthesis, photosynthate accumulation and possibly distribution for high yield.

Interaction of fertilizer and variety on the yield and yield components

The interaction of fertilizer and variety on some of the growth and yield characters such as number of branches, number of nodes and number of flowers shows that the two varieties behaved differently under different fertilizer levels. This may be attributed to the different varieties under study. NC-1 responded more to higher fertilizer level than NC-2 which explains the interaction (Fig 1-3).

Conclusion and Recommendation

From the study, the following conclusions can be deduced.

1. There were no significant difference between the two varieties studied with respect to yield and yield characters in Anyigba environment.
2. Fertilizer application significantly increased the yield of the two varieties. However, NC-2 (green variety) appears to respond more to higher N-application (up to 200kgN/ha) as compared to NC-1 (off-white variety).
3. The interaction obtained between variety and fertilizer application is an indication that the varieties did not behave alike after all. Fertilizer recommendation in future therefore should be variety-specific rather than blanket.
4. Without prejudice to all characters ascribed to NC-2 (green variety), NC-1 being off-white in colour appears to be more preferred and more consumed (given the preponderance of eat in the market) may be recommended for production in Anyigba environment.

References

Akanbi, W.B (2002). Growth, Nutrient uptake and yield of maize and Okra as influenced by Compost and Nitrogen Fertilizer under different Cropping Sysstem. *PhD. Thesis, University of Ibadan, Nigeria*: 228pp

Adepetu, J.A (1986). Soil fertility and fertilizer requirement in Oyo, Ogun and Ondo state. *FDALR, Federal Ministry of Agriculture and Water resources, Publ.* Lagos.

Amhakhian, S., Osemwota, I., and Oyewole, C.I (2012). Response of maize (*Zea mays* L.) Yield and Yield components to rate of applied fertilizer in the Guinea savanna soils of Kogi State, Nigeria. *Journal of biology, Agriculture and Healthcare* Vol. 2(3): 2224-3208

AVRDC, (2008). Eggplant production (Internet). Available from http://www.avrdc.orgi/c/eggplant/borerhtml.

Bar-Tal A., Aloni B., Karin L., Rosenberg R. (2001) Nitrogen nutrition of greenhouse pepper: Effects of nitrogen concentration and NO_3:NH_4 ratio on growth, transpiration, and nutrient uptake. *J. Hort. Sci.* 36:1525-1529

Collonnier C, Fock, I, Daunay M.I, Servaes A, *et al* (2003). Somatic hybrids between *Solanum melongena* and *S. sisymbrifolium*, as a useful source of resistance against bacterial and fungal wilts. *Plant Sci. 164: 849-861*

Cassman, K.G, Doberman, A, Water, D.T. (2002). Agro-ecosystems nitrogen use efficiency and nitrogen management *AMBIO* 31, 132-140.

Danquah –Jones, A. (2000) vitamins and correlation among agronomic traits in garden egg (*Solanum radii*). *Department of crop science, Accra university of Ghana, Legon* 30.

Devi H.H., Maity T.K., Paria N.C., Thapa U (2002). Response of brinjal to different sources of nitrogen. *J.Veg. Sci.* 29(1):45-47

Ge T., Song S., Chi M., Huang D., Iwasaki K (2008). Effects of nitrogen forms on carbon and nitrogen accumulation in tomato seedling. *J. Agric. Sci. China.* 7(11):1308-1317

Hedge, D.M., (1997). Nutrient requirement of Solanaceous vegetable crops, food and Fertilizer Technology; *Tech. Bull 9pp.*

Li, K, Reddy, M.R. Nitrogen concentration in the soil-water atmospheric continuum in a sustainable cropping system in agronomy. *Abstract; Agricultural Society of America: Anaheim, CA, USA,* 1997; p.271.

Little, T.M and Hills, F.J. (1978). Agricultural Experimentation: Design and Analysis, John Wiley and Sons, Inc., *New York*. pp350.

Mohammad Hossein Aminifard, Hossein Aroiee, Hamide Fatemi, Atefe Ameri, Sajede Karimpour (2010). Responses of eggplant (solanum melongena l.) To different rates of Nitrogen under field conditions. *Journal of central European agriculture* Vol. 11 No. 4 (453-458).

Okozie, C.A and Okaye, B.C. (2006). Determination of technical efficiency among eggplant (*Solamun* spp). Farmers using the stochastic frontier model in Isialangwa Area of Abia state, Nigeria. *Agricultural journal* 1(3); 119-122

Oyewole C.I, E.S Akogu and E.S Attah (2014). Response of Eggplant (*Solanum melongena L.*) to Nutrient Sources and Rates of Application: I. Yield Components and Fruit Yield. *International Journal* of *Agriculture and Biosciences* 3(4): 166-172**.**

Pal, S., Saimbhi, M.S., Bal, S.S (2002). Effect of nitrogen and phosphorus level on growth and yield of Brinjal hybrid (*Solanum melongena* L.). *J. Veg. Sci.* 29, 90-9.

Prabhu M., Veeraragavathatham D., Srinivasa K (2003). Effect of nitrogen and phosphorous on growth and yield of brinjal. *South-Indian-Hort.* 51(1/6):152-156.

Robert, K.M and Andrew, J.W (1989). An Introduction to crop physiology. *New York: Longman Scientific and Technical, Willey;* 340pp

Suge, J.K., M.E, Omunyin and E.N Omami. (2011) Effects of organic and inorganic source of fertilizer on growth, yield and fruit quality of eggplant *(Solanum melongena L.) Archives of Applied science Research,* 3(6) 470-479

Snedecor, G.W and Cochran, W.G. (1967). Statistical Methods, 6th edition, p: 465. *lowa State University Press U.S.A*

Wange S.S., Kale, R.H., (2004) Effect of bio fertilizers and nitrogen level on Brinjal crops. *J. Soils Crops.* 14(1): 9-11.

Table 1. Result of soil analysis

Physical properties (%)	**Depth (0-30cm)**
Clay	8.32
Silt	5.72
Sand	82.96
Textural Class	Sandy-loam
Chemical properties (%)	
pH (H_2O)	7.3
Organic carbon	0.72
Total nitrogen (%)	0.0014
Available phosphorus (ppm)	8.6
Exchangeable cations	
Calcium (Cmol/kg)	4.42
Magnesium (Cmol/kg)	1.51
Potassium (Cmol/kg)	2.61
Sodium (Cmol/kg)	1.17
Cation exchange capacity (CEC)	10.49

Table 2. Effect of fertilizer, variety and interaction on growth characters.

	Growth characters		
	Number of leaves	Mean height	Mean girth
Fertilizer			
Control (0kgN/ha)	121.73^{c}	144.56^{c}	16.27^{c}
100kgN/ha	166.91^{b}	178.52^{b}	18.88^{b}
200kgN/ha	211.48^{a}	203.55^{a}	22.31^{a}
Significance	**	**	**
F-L.S.D	6.14	4.87	0.45
Variety			
NC-1	246.79	253.2	27.07^{b}
NC-2	253.33	281.43	30.39^{a}
Significance	ns	ns	*
F-L.S.D			0.45
Interaction			
V×F	ns	ns	ns
C.V (%)	21.09	14.80	13.61

Means followed by the same letter(s) within a sampling stage is not statistically significant at 5% level of probability using DMRT.

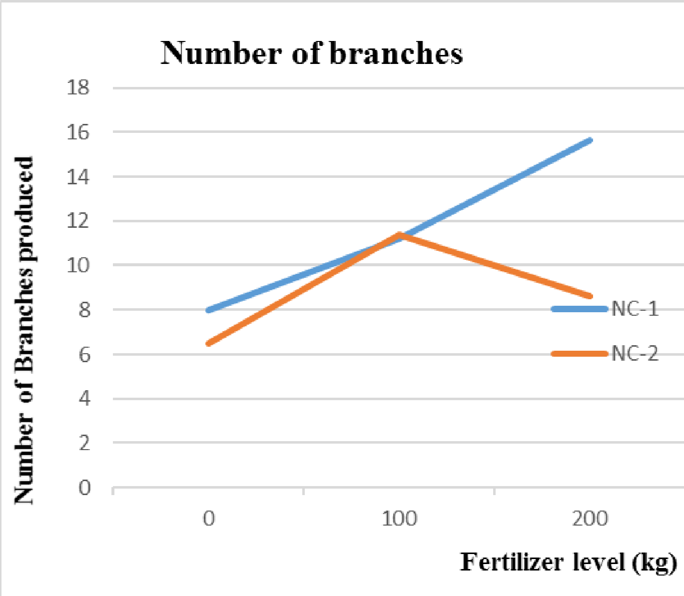

Fig. 1 Interaction (F×V) of fertilizer and variety on number of branches

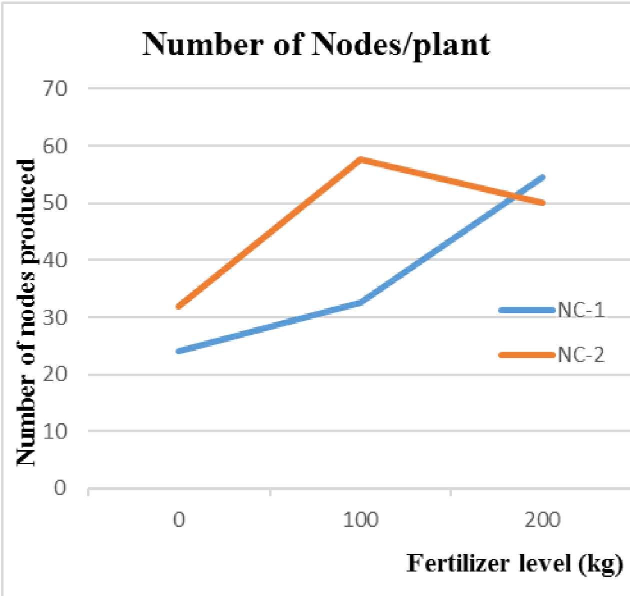

Fig. 2 Interaction (F×V) of fertilizer and variety on number of nodes.

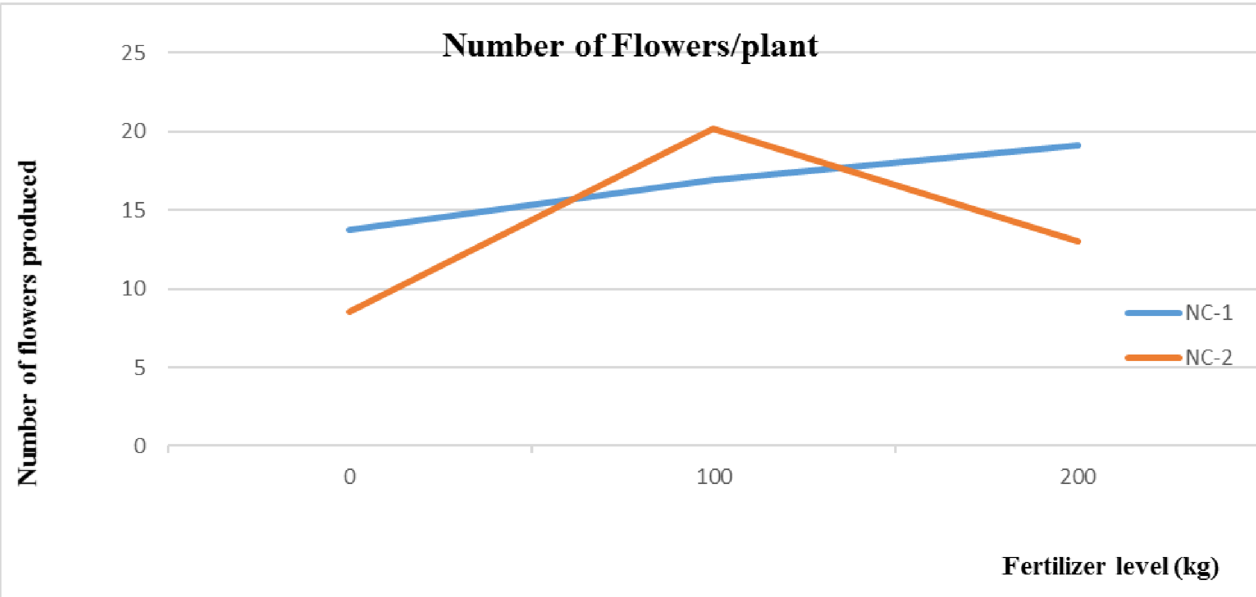

Fig. 3 Interaction (F×V) of fertilizer and variety on number of flowers/plant.

Table 3. Effect of fertilizer, variety and interaction on yield components.

	Yield components					
	Number of flowers/plant	Number of nodes/plant	Number of branches/plant	Number of fruits/plant	Fruit diameter	Fruit yield/plant
Fertilizer						
Control (0kgN/ha)	22.34^{c}	55.99^{c}	14.49^{c}	51.0^{c}	17.80	10.63^{c}
100kgN/ha	37.07^{a}	90.22^{b}	22.62^{b}	111.00^{a}	26.20	21.38^{b}
200kgN/ha	32.13^{b}	104.48^{a}	24.25^{a}	82.00^{b}	25.60	21.89^{a}
Significance	**	**	**	**	ns	**
F-L.S.D	0.99	3.19	0.94	2.14		1.11
Variety						
NC-1	49.82^{a}	111.18^{b}	34.82^{a}	122	33.20	26.65
NC-2	41.72^{b}	139.51^{a}	26.54^{b}	122	36.40	27.25
Significance	*	*	*	ns	ns	ns
F-L.S.D	0.99	3.19	0.94			
Interaction						
V×F	**	**	*	ns	ns	ns
F-L.S.D	0.99	3.19	0.94			
C.V (%)	17.41	20.25	24.39	13.95	5.80	32.66

Means followed by the same letter(s) within a sampling stage is not statistically significant at 5% level of probability using DMRT.

Table 4: Interaction of N-Fertilizer and Variety on Numbers of Branches.

Fertilizer	N.C-1	N.C-2
Control (0 kg N/ha)	7.99^{d}	6.50^{e}
100kg N/ha	11.21^{c}	11.41^{b}
200kg N/ha	15.62^{a}	8.63^{d}
F-L.S.D	0.94	

Table 5: Interaction of N-Fertilizer and Variety on the Numbers of Nodes at 9WAT.

Fertilizer	N.C-1	N.C-2
Control	24.06^{d}	31.93^{c}
100kg N/ha	32.64^{c}	57.58^{a}
200kg N/ha	54.48^{a}	50.00^{b}
F-L.S.D	3.19	

Table 6: Interaction of N-Fertilizer and Variety on Numbers of Flowers at 9WAT.

Fertilizer	N.C-1	N.C-2
Control	13.77^{d}	8.55^{e}
100kg N/ha	16.91^{c}	20.16^{a}
200kg N/ha	19.12^{b}	13.01^{d}
F-L.S.D	0.99	