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Effect of NPK Fertilizer and Transplant Age On Growth, Fruit Yield And Nutritional Content Of *Solanum Melongena* South Western Nigeria

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ABSTRACT

Good and sustainable agronomic practices are needed in vegetable production to maintain high crop yield. As part of efforts to achieve this, two field experiments were carried out between 2008 and 2010 to evaluate the combined effects of age of transplant and NPK fertilizer on the growth, fruit yield and quality of *Solanum melongena var.'* long purple'. Four levels of NPK fertilizer (0, 200, 300 and 400 kg NPK/ha) and three ages of transplanting (5, 6 and 7 weeks after sowing) in 12 factorial combinations were the treatments. These were laid out in randomized complete block design replicated thrice. Data collected were subjected to analysis of variance and significant means compared using least significant difference (LSD) at 5% probability level.

All the growth parameters and fruit attributes assessed increased with increasing levels of NPK. Application of 300 kg NPK/ha produced the best growth while plants that received 200 kg NPK /ha and non-fertilized plants had least performance. The fruit and seed attributes such as fruit length and girth, number of fruits/plant, number of seeds/fruits, seed weight, and fruit yield were all significantly influenced by the fertilizer levels. The number of fruits/plant ranges from 4.3 in non- fertilized plants to 8.2 in 300kg NPK /ha treatment. There was no significant difference in fruit yield produced by 300 (26.88 t /ha) and 400 kg (28.78 t /ha) NPK /ha treatments. Transplanting of seedling at 6 weeks after sowing (WAS) produced significantly better plant growth, fruit attributes and fruit yield compared to plants transplanted at 5 and 7 WAS. It can be concluded that application of 300 kg NPK /ha in combination with transplanting of seedlings at 6 weeks are good agronomic practices that could ensure optimum performance of *Solanum melongena.*

Key words: *Solanum melongena,* NPK fertilizer, age of transplant, growth, fruit yield

INTRODUCTION

Egg plant (*Solanum melongena*) is one of the most important fruit vegetables in the tropical and subtropical countries of the world. It is a fruit of high dietary value. The young and almost mature fruit are eaten raw or used as vegetable (Edmond *et al; 1985*). Nutritional, per kg fresh fruit of eggplant on the average contained 90ml water, 1.0g crude protein, 0.2g fat, 7.0g carbohydrate, 1.3g crude fibre, 14mg Ca, 26mg P, 1.3mg Fe and 9.0mg ascorbic acid (Tindal, 1986). In order to fully exploit the nutritional values of this crop, there is need for good agronomic and sustainable practices.

The use of fertilizer is an age long practice in agriculture. Fertilizer when applied with latest technology could improve crop growth and development as well as crop quality and quantity of the produce. Fertilizers contribute to increased crop production by replenishing lost nutrients, maintain and enhance soil fertility and thereby sustain crop production. This concept also enables adoption of high yielding varieties which increases yield several fold (FAO, 1993). Like any other source of plant nutrients, fertilizer can contribute to environmental damage unless managed properly. For instance the use of chemical fertilizer has been found to be associated with pollution of underground water and may have negative effects on crop quality (Hegde, 1997; Ogoke *et al 2003*); hence caution is required as to the type and doses of fertilizer to use under different agro ecological zone. Also, the current prices of fertilizers call for its economic utilization to meet specific requirements of crops, produce optimum yield, improve produce quality and prevent deposition of surplus nutrients and toxic substances in plant products (Babatola *et al*; 2008). Fertilizer application could produce its expected results if it is applied in accordance with the latest concept and knowledge and in combination with other good agronomic practices (Rasthore *et al; 2010*). Egg plant (like most other solanaceous plants) takes up large amounts of nutrients. The amount of nutrients it takes depends on the quantity of fruit and dry matter produce, which in turn is influenced by genetic and environmental (soil nutrients inclusive) variables (Hegde, 1997; Savvas and Lenz, 2000). According to Savvas and Lenz (2000) in the absence of any other production constraints, nutrient uptake and yield have been found to be closely related, and they depend to large extent on the soil nutrient status (Adesina *et al 2003*). The consequences of differences in the availability of nutrients for production of quality crop and other vegetable characteristics are well known. Adequate supply of nutrients stimulates the production of a large leaf area index, through branching and leaf size expansion, with a high chlorophyll content which absorbs radiation efficiently (Odeleye *et al* 2001). The photosynthetic capacity of leaves is larger, resulting in a higher arte of photosynthesis and large biomass production. This leaves enough photosyntentates which could be partition into the fruits. Adequate supply of required nutrients is therefore needed in order to obtain egg plant fruits that will meet world quantitative and qualitative requirements.

Age at transplanting is an important factor in the production of horticultural crops. Transplanting of too young or old seedlings has effects on the subsequent growth and development of the crop concerned. For instance Akanbi *et al* (2001) observed that transplanting of *S. macrocrpon* seedlings at 6 weeks enhanced good seedling establishment and shoot and fruit production. They further stated that transplanting at ages below or above this produces negative effects. Generally, transplanting of seedlings at immature age could predisposes the seedlings to vagaries of weather and pests and increase crop stand loss on the farm. On the other hand delaying transplanting produces seedlings with excessive roots and foliage. This may makes the seedlings to be prone to excessive root damage (IBPGR, 1990) which has effects on crop subsequent development, and eventually yield. So therefore, timely transplanting of the seedlings is tantamount to having expected yields in horticultural crops. This work has it as objectives to investigate into the contribution of appropriate fertilizer application in combination with timely seedling transplanting on the optimum growth, fruit yield and nutritional value of *Solanum melongena*.

MATERIALS AND METHODS

Two field experiments were conducted between 2008 to 2010 at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso (Long. 4^o 10'E; Lat. 8^o 10' N) , Nigeria. The experimental site has been under guinea grass fallow for two years prior to cultivation in 2008. For the 2010 trial, the field was used to grow maize before used. In both years, soil samples were collected and subjected to chemical analysis. The results show, on the average, 0.17% N; 2.94% P and 1.06% organic matter.

Seeds of 'long purple' variety of egg plant obtained from the genetic unit of the National Horticultural Research Institute (NIHORT), Ibadan, Nigeria were raised in the nursery for 5 to 7 weeks before transplanted to the field. The seedlings were adequately watered and protected from harsh weather by providing light shade which was removed some days prior to transplanting to hardening up the seedlings. Nursery insect pests and diseases were controlled by spraying with combination of karate and Benlate as recommended by NIHORT (1986).

The field used were cleared, ploughed and harrowed once each to obtained good seed bed. The field was demarcated into 3 blocks. Each block (47m x 3m in dimension) consisted of 12 plots. A plot measured 3m x 3m. At the time of transplanting, the seedlings were watered heavily to prevent excessive damage to the roots when lifted. The seedlings were transplanted at the appropriate ages at a plant distance of 60 cm x 60cm. This gave 27, 777 plant stands per hectare.

The treatments applied were four levels of NPK 15-15-15 fertilizer (0, 200, 300 and 400kg NPK /ha) and three ages of transplanting (5, 6 and 7 weeks after sowing). Since the lowest rate for NPK fertilizer that the local farmers use is 200 or 300kg NPK /ha, 200kg was selected in this study as the lowest rate (FPDD; 1990).

The factorial combinations of the two factors produced 12 treatment combinations which were laid out in randomized complete block design replicated thrice. The NPK fertilizer treatments were applied by side placement in two equal split doses at one and five weeks after transplanting (for each age of transplanting) to prevent nutrients loss. These correspond to period of active vegetative development and flower initiation, respectively in the test crop (IBPGR, 1990). In order to keep the plants pest and disease free, the fungicide Benlate at the rate of 0.4 kg a. i. /ha and the insecticide – Karate EC at the rate of 300ml /hectare were sprayed on fortnight basis starting from three or four weeks after transplanting (WAT) for 2008 and 2010 trial, respectively and continue throughout the period of the experiment. The plants were staked at 4WAT with 1m stakes to prevent some diseases and fully exposed the plant leaves to solar radiation. Weed free plots were achieved throughout of the experimental periods by three hand weeding at 3, 6 and 9WAT for 2008 trial and two at 4 and 8 WAT for 2010 trial.

Bi-weekly samplings of plants (4 plants /treatment) were carried out from 3 WAT of the last sets of the seedlings until 12 weeks when plants had produced ripped fruits. At each sampling time, growth measurements were taken on plant height, stem girth, number of leaves, number of offshoots, leaf area, leaf area index, and dry matter yield using a mean of four plants. However, in this report, the data obtained at 6WAT were reported. At this age, the plants were at the peak of vegetative development. For determination of dry matter accumulation, at 6 WAT (in each trial) plants were carefully uprooted and washed gently under the running water to remove the sand. There after fresh weights were taken as well as dry weight after oven dry the materials at 400^oC for 48 hours. The selected reproductive, fruit and seed parameters such as , cumulative number of flowers and fruits, % fruit sets, fruit length and diameter, fruit weight, total fruit yield, number of seeds per fruit, seed weight and % seed germination were measured as appropriate during the course of the experiment (AVRDC; 1978). At 9 WAT the last sets of the seedlings and when most of the fruit are at maturity stage, 6 fruits per treatments were harvested to determine their nutritional content. The fresh fruit water, crude protein, fat and oil, carbohydrate, crude fibre, Ca, P, Fe, and ascorbic acid contents were determined. The samples were prepare and analyzed by the procedures of Bremner (1965) and Ulger *et al* (1997). Data collected were subjected to analyses of variance, and the means separated with LSD or DMRT.

RESULTS

NPK fertilizer and age of transplants effects on any growth parameters.

The plant height was affected by both the NPK treatment and age of transplant. At lower fertilizer rates (0 and 200kg NPK /ha) there was a slight reduction in plant height (Table 1). The tallest plant was obtained with application of 400kg NPK /ha. In case of number leaves per plant there was a significant difference for the different N rates. The values obtained for this trait ranged from 41.9 in no fertilizer plants to 84.9 leaves per pant in plants treated with 200kg N /ha. Nutrient supplied had significant effects on leaf area of the eggplant (Table 1). There were significant differences among fertilizer rates on the plant leaf area, with reductions of as much as 29% for the nutrient stress treatment. These results agree with those presented by Muchow (1988) and Seigio *et al* (1995). They reported a high effect of nutrient availability on leaf expansion rate and size. The most important functions of leaves is to produce assimilate through photosynthesis. The leaf nutrient conditions, most especially N content, are one of the key factors in determining the rate of photosynthesis. Hence, for optimum development of crop foliage and its effective functioning, adequate nutrient must be made available for growing plants (Ulger *et al;* 1997; Odeleye *et al*; 2001). In the present study, plants subjected to nutrient stress recorded lower number area of leaves. This could be part of the reasons for poor dry matter accumulation recorded in plants treated with 0 and 200Kg NPK /ha.

Per plant number of offshoots and dry matter yield were reduced by nutrient deficiencies. The least offshoot was produced by plants that received no fertilizer while application of 200, 300 and 400kg NPK /ha produced significant 15.2, 76.7 and 56.8% respectively, increase in number of off shoot. Dry matter accumulation varied significantly acrossed applied fertilizer rate. The order of decrease in dry matter production was 0 < 400 < 300 < 200 kg NPK /ha. However, variability of dry matter yield was not significantly different for the different NPK levels.

Leaf area index (LAI) was significantly affected by fertilizer shortage. The LAI among NPK treatments significantly varied from 0.21 in 300kg NPK /ha to 0.28 in plants that received 200kg NPK /ha. This is in line with observation of Sergio *et al* (1995). In their report N- stress had effect on leaf expansion and eventual LAI. Nutrient deficiencies produced a delay in crop LAI relative to the control.

Age of transplant had significant effect on considered eggplant growth parameters (Table1). All the parameters considered were highly ($P \leq 0.01$) influenced by age of transplant. Seedling transplanted at 6 week of age consistently performed better than other ages. Transplanting of seedling at 6 week gave the best leaf size which is 22 and 12% higher than what was obtained when the seedlings were transplanted at 5 and 7 week For all the growth parameters taken, the order of increment were 5 < 7 < 6 weeks of age. This agrees with the report of Hegde (1997) and Akanbi *et al* (2001). Akanbi *et al* (2001) observed better performance of 6 week old seedlings of *Solanum macrocarpon*. This was attributed to better seedling vigour and moderate root biomass associated with seedlings of this age. This improved their ability to withstand transplanting stress.

The interactions of fertilizer with age of transplant significantly ($P \leq 0.01$) affected the growth parameters of egg plant (Table 1). Seedling transplanted at 7 weeks old and received the highest rate of NPK fertilizer produced the tallest plant. On the other hand, 6 week x 300 kg NPK /ha treatment produced the most robust plants. Leaf area production was highest with 7 week old seedlings that received 200 kg NPK /ha and it is this same combination that produced plants with the best dry matter yield.

NPK fertilizer and age of transplant effects on reproductive, fruit and seed parameters.

NPK fertilizer and transplanting age significantly affected ($P \leq 0.05$) the reproductive, fruit and seed parameters of eggplant (Table 2). The mean numbers of flowers and fruits as well as % fruit set were all at highest with application of 300kg NPK /ha. These parameters increased with increasing application rate from 0 to 300kg and beyond reduced. The numbers of fruits /plant was least with non fertilized plant and increased by 47, 91and 65 % when application rate increased to 200, 300 and 400kg NPK /ha, respectively. The % fruit set followed the pattern observed with number of flowers and fruits with the highest value (58.6%) obtained with 300kg NPK fertilizer rate while non fertilized plants gave the least. It should be noted however, that for number of flowers and fruits and % fruit set, the values obtained for 300 and 400 kg NPK /ha were statistically insignificant. The decline in number of flowers and fruits, and % fruit set at 0 and 200kg NPK /ha was an effect of a poor nutrient supplied. This observation could account for lower fruit and seed yield in this study. This corroborate the results obtained by Ulger *et al* (1997) and Akanbi *et al* (2001) where they reported the significant benefits derivable from adequate application of fertilizer to fruit vegetables.

There was a significant linear relationship between applied fertilizer rate and fruit length. The shortest fruit (7.2cm) was produced with 0 kg and this was significantly different only from the values obtained with 300 and 400kg NPK treatments. The seed parameters were significantly influenced by NPK fertilizer. The least number of seeds /fruit were extracted from plants grown without any fertilizer while plants nourished with 200 kg NPK produced the highest. Unlike what was observed with the number of seeds /plants, seed weight /fruit was highest with 300 kg NPK /ha treatment. The value obtained with this treatment was 50, 43, and 67 % significantly higher than 0, 200 and 400 kg NPK treatment, respectively. Ability of the harvested seeds to germinate varies significantly with NPK fertilizer rates. Percent seed germination ranged from 39.1% in 0 to 66.7% in 400kg NPK /ha. Nevertheless the % seed germination obtained with 300 and 400kg NPK /ha treatments were similar.

Influence of age of transplant on selected reproductive, fruit and seed parameters, namely per plant number of flowers and fruits, % fruit set, fruit length and girth, number of seeds /fruit, seed weight /fruit and % seed germination are pretended in Table 2. All the parameters were significantly ($P \leq 0.01$) influenced by age of transplant. The least number of flowers per plant was obtained with seedlings transplanted at 5 week old while the oldest seedlings produced the highest. This is similar to what was observed for number of fruits with the exception that 6 week old seedlings produced the highest value. Result of %fruit set in response to age of transplant is in contrary to that of number of flowers and fruits per plant. The earliest transplanted seedlings produced the highest % fruit set while the least is from 7 week old transplanted seedlings. Other fruit and seed characteristics studied (fruit length and girth, number of seeds /fruit and %seed germination) showed similar response to age of transplant. In these parameters, the oldest seedling gave the highest values, followed by 6 week age ones while 5 week transplanted seedlings gave the least. Also seed weight /fruit was highly influenced by the age of transplant. In this trait, transplanting of seedlings at 5 and 6 weeks produced similar results which were significantly better than what 7 old transplants produced.

Data on the interactive effects of fertilizer and age of transplant on reproductive, fruit and seeds parameters are presented in Table 2. The best number of flowers and fruits per plant were obtained with seedling transplanted at 6 weeks and received 300 kg NPK /ha whereas 5 week x 300kg NPK /ha treatment produced the highest %fruit set. As much as number of seeds and seed weight /fruit, and %seed germination are concern, it was 7 week old transplant nourished with 300kg NPK /ha that gave the highest response.

Cumulative fresh fruit yield was influenced by NPK levels, age of transplant and their interactions (Figure 1, Table 3) in 2008 and 2010. The yield response to NPK and age of transplant was statistically important. Although, year effect was insignificant, the fruit production in 2008 was better than that of 2010. The yield response to NPK rates was very distinct especially with 0, 200 and 300kg applications. There were 100 and 21% yield increase when fertilizer rates were increased from 0 to 200 and 300kg, respectively. A similar result on crop yield with increasing fertilizer rate was recently reported by Durieu *et al* (1994) and Ulger *et al* (1997).

Yield response to age of transplant was not as large as that for fertilizer rate. Increments compared to 5 week transplant age were 39 and 44% for the 6 and 7 age of transplants, respectively (Figure 1). Fruit yield with 6 week old transplant was not significant from value obtained with 7 week old ones. The interactive effect of the tested factors on cumulative fresh fruit yield was highly significant ($P \leq 0.01$) (Table 3). Highest fruit yield of 32.33t /ha was obtained with 6 week old transplant fertilized with 400kg NPK /ha. This was however, not statistically significant from what was observed with 6 week x 300kg NPK /ha treatment.

Fertilizer and age of transplant effects on nutritional value.

The nutritional contents of eggplant were statistically influenced by NPK rates, age of transplant and NPK by age of transplant interaction (Table 4). The crude protein (CP) increased gradually from 0.84g /kg with 0 to 1.38g /kg in 300 kg N /ha. There was slight non - significant reduction in CP as the fertilizer level increased from 300 to 400kg NPK /ha. Application of 200 kg NPK /ha produced the highest ether extract (EE) and this was 69, 63 and 65% higher than what was obtained with plant fertilized with 0, 300 and 400 kg NPK /ha, respectively. The EE of plants nourished with 300 and 400kg NPK /ha were statistically indifference. Contrarily, crude fibre (CF) content of the test crop in response to applied fertilizer rates decreased with increasing in NPK up to 300kg /ha before increased again. The carbohydrate (CHO) accumulation varied significantly with applied fertilizer rates. The least CHO content was determined from fruit of plants that received 0 kg NPK /ha and this was significantly lower than CHO obtained from other fertilizer rates. The CHO contents of plants nourished with 200, 300 and 400 kg NPK /ha were however not significant. The mineral contents of eggplant determined in this study namely Ca, P, Fe and ascorbic acid were significantly ($P \leq 0.01$) influenced by NPK rates. For these traits, application of 300kg NPK /ha consistently out performed other fertilizer rates. Also, for most of them, 300 and 400kg NPK /ha treatments performed similarly.

Age of transplant in relation to the eggplant fresh fruit nutritional values was significant (Table 4). The only exceptions to this are Ca and Fe contents. Among the parameters that show significant response to the age of transplant, transplanting of seedlings at 6 week old repeatedly produced the best results. The fruit CP content ranged from 0.96 in 5 week old transplants to 1.31g /kg in plants which seedlings were transplanted at 7 weeks. The CP of 6 and 7 week old transplant were comparable. The EE was highest in 6 week transplant and this was 71 and 55% higher than EE of 5 and 7 old transplants, respectively. In case of CF, inverse relationship was observed with age of transplant. The order of decease in CF with the age of transplant were 7 < 6 < 5 week old transplant. The P and ascorbic acid contents varied significantly with transplant age. The P content of 5 (19.30mg /kg) and 7 (20.79mg /kg) old seedlings were significantly lower than that of 6 weeks transplant (21.95mg /kg). Ascorbic acid was highest in 6 old transplants while 5 old ones gave the least. The interactive effects of fertilizer rate and age of transplant on nutritional content of eggplant fresh fruit were significant (Table 4). The highest CP content was produced by 6 week old transplant fertilized with 300kg NPK /ha. Similarly EE ranged from 0.10g /kg in 6 x 0kg NPK /ha treatment to 0.22 in 6week x 300kg NPK /ha combination. The highest CF (2.20g /kg) was observed with no fertilized plants transplanted at 5 week old while the least (1.21g /kg) was obtained with plant that received 300kg NPK /ha and established with 6 week old seedlings. The total CHO accumulation was highest in plants that were established with 6 week old seedlings and fertilized with 200 kg NPK /ha and this was not significantly different from seedlings of the same age that received 300 and 400kg NPK /ha. Accumulation of Ca, P and ascorbic acid were highest in 6wek transplant x 300kg NPK /ha combination while 5 week old seedling with the highest N level produced the best Fe content.

Response of eggplant fresh fruit nutritional values to fertilizer shows that application of fertilizer was justified were there is nutrient stress. The CP, EE, P, Fe and ascorbic acid contents of eggplant fruit increased with increasing rates of applied fertilizer. This might be due to more availability and better utilization of nutrients at higher NPK levels. These results corroborate the findings of Ulger *et al (1997).* In the report, an increase in nutritional value of corn seeds was observed with availability of adequate amount of nutrients. With this, nutrient uptake, and assimilation as well as as dry matter production and partitioning were all found to be enhanced. This invariably improved the quality of the crop economic products. This implied having produce of high nutritional value with adequate fertilizer application.

SUMMARY

The study examined the contribution of age of transplant and NPK fertilizer on egg plant growth, fruit yield and nutritional values. Transplanting of seedlings at 6 week old in combination with application of 300 kgNPK /ha significantly enhanced fruit yield and quality of the crop in South Western Nigeria.

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Table 1: Main and interactive effects of fertilizer and age of transplant on eggplant growth parameters

Treatment	Stem height (cm)	Stem girth (cm)	Leaf area /plant (cm^2)	Number of leaves /plant	Number of offshoots /plant	Dry matter yield /plant (g)	Leaf area index
NPK level (kg /ha)							
0	31.2d	2.7c	638.3b	41.9a	24.6b	39.6c	0.22b
200	33.2c	3.2a	820.6a	69.7d	16.8d	64.2a	0.28a
300	35.0b	3.0b	657.1c	84.9b	25.8a	58.8ab	0.21c
400	39.8a	2.8c	659.4c	78.7c	22.9c	56.4b	0.23b
Age of transplant (Weeks)							
5	31.7c	2.8b	638.5c	63.4c	21.9b	54.4a	0.21c
6	38.8a	3.3a	779.0a	104.6a	33.7a	58.7a	0.26a
7	33.9b	2.7b	694.1b	75.6b	12.0c	51.2b	0.24b
NPK x Age interactions							
5 x 0	24.0	2.3	361.7	83.3	29.4	36.4	0.12
5 x 200	37.0	3.2	7400.0	51.5	23.5	61.9	0.26
5 x 300	37.3	3.3	659.3	73.3	19.4	58.9	0.21
5 x 400	28.3	2.4	753.0	45.5	15.1	300.2	0.25
6 x 0	38.3	3.2	866.3	85.5	30.3	41.8	0.28
6 x 200	200.1	3.2	756.7	400.2	18.5	72.4	0.26
6 x 300	35.0	3.3	761.7	139.3	47.3	300.4	0.25
6 x 400	41.30	3.4	731.3	113.3	38.5	300.2	0.24
7 x 0	31.2	2.5	4007.0	105.3	14.2	200.6	0.27
7 x 200	22.4	3.3	925.0	77.6	8.4	58.4	0.31
7 x 300	32.3	2.5	550.3	42.1	10.5	57.2	0.18
7 x 400	49.7	2.5	494.0	77.3	15.1	48.7	0.19
LSD (5%):							
NPK x Age	1.23	0.18	4.96	0.92	0.46	3.23	0.01

Means along the same column for each factor are not significantly different using DMRT at 5% probability level

+ values are average of 2008 and 2010 data

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Table 2: Main and interactive effects of fertilizer and age of transplant on selected reproductive, fruit and seed parameters of eggplant

Treatment	No. of flowers/pl ants	No. of fruits/ plant	% fruit set	Fruit length (cm)	Fruit girth (cm)	Number of seeds /fruit	Seed weight / fruit (g)	Seed germination (%)
NPK level (kg /ha)								
0	10.9d	4.3c	200.4b	7.2c	7.1a	1290.6d	5.8b	39.1c
200	13.6c	6.3b	46.7b	7.8c	6.9a	2184.6a	6.1b	59.3b
300	16.0a	8.2a	58.6a	10.4b	6.1b	1698.1b	8.7a	66.3a
400	15.5b	7.1ab	48.6ab	12.5a	6.5ab	1566.4c	5.2c	66.7a
Age of transplant (weeks)								
5	9.6c	5.6b	57.3a	6.6c	6.6ab	1225.8c	6.6a	55.3c
6	14.5b	7.0a	48.9a	10.0b	6.3b	16300.6b	6.5a	62.5a
7	17.9a	6.9a	39.5b	11.8a	7.0a	2168.3a	6.3a	55.8b
NPK x Age interactions								
5 x 0	5.3	1.8	33.9	4.0	5.3	755.0	4.3	36.9
5 x 200	13.5	5.6	41.5	5.6	7.1	1884.3	8.3	54.1
5 x 300	9.6	8.4	87.5	11.1	9.1	1218.0	8.3	61.0
5 x 400	10.1	6.7	66.3	5.8	4.5	1046.0	5.5	70.0
6 x 0	10.3	5.8	56.3	8.3	6.3	1622.3	7.1	51.0
6 x 200	14.1	6.2	43.9	5.5	4.2	1825.0	6.5	63.1
6 x 300	17.3	9.6	55.5	8.4	6.5	1613.0	7.4	67.5
6 x 400	16.1	6.4	39.8	18.0	8.0	1582.0	4.7	69.0
7 x 0	17.1	5.3	31.0	11.0	7.5	1494.3	5.6	30.4
7 x 200	13.0	7.1	54.6	10.7	7.1	2844.0	3.5	61.0
7 x 300	21.1	6.9	32.7	11.7	7.5	2263.1	10.5	71.0
7 x 400	20.4	8.1	39.7	13.6	6.0	2071.3	5.4	61.1
LSD (5%)								
NPK x Age	0.86	0.81	0.52	1.20	0.61	21.22	0.27	5.1

Means along the same column for each factor are not significantly different using DMRT at 5% probability level

+ values are average of 2008 and 2010 data

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(a)

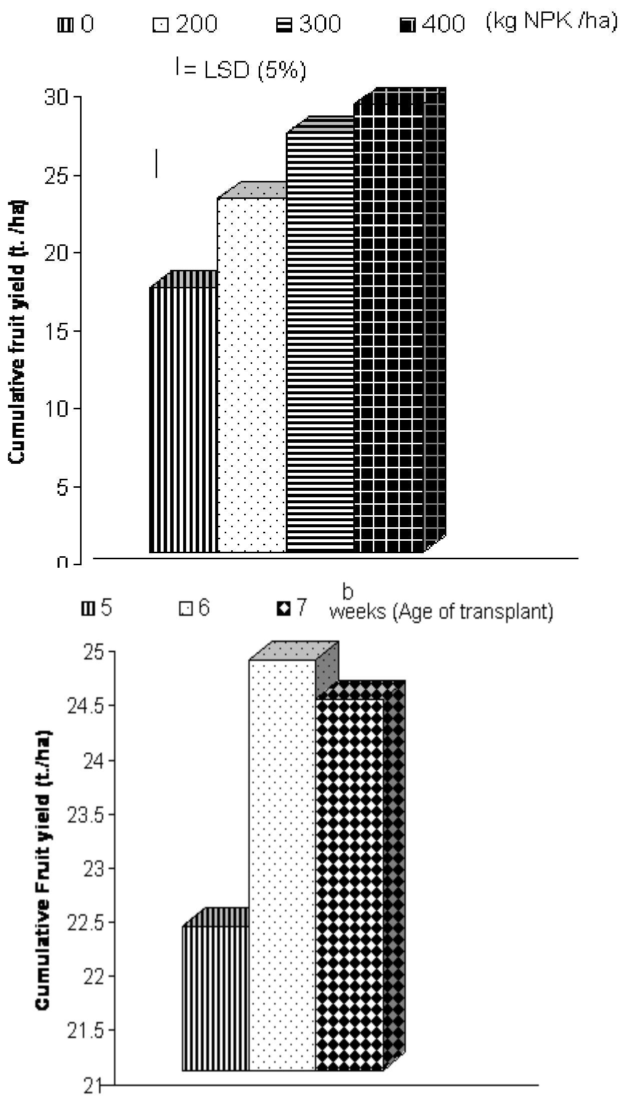

Fig. 1: Effects of (a) NPK rates and (b) age of transplant on eggplant cumulative fruit yield

Table 3: Interactive effects of fertilizer and age of transplant on cumulative fruit Yield of eggplant in 2008 and 2010

Age of transplant (Week)	NPK Fertilizer level (kg /ha)	Year	
		2008	**2010**
5	0	7.0	2.8
	200	24.9	13.7
	300	30.3	23.0
	400	27.0	24.8
6	0	18.5	13.2
	200	16.7	16.6
	300	31.7	31.0
	400	32.3	23.3
7	0	25.4	14.3
	200	26.7	17.4
	300	18.7	23.3
	400	27.0	24.1
Mean		**23.9**	**18.9**
F^{Test} (5%):			
Year:	ns		
Age:	**		
Fertilizer:	**		
Year*Age:	**		
Year*Fertilizer:	**		
Age*Fertilizer:	**		

****, ns = Significant at 0.01 probability level, not significant**

Table 4: Main and interactive effects of fertilizer and age of transplant on nutritional quality of fresh eggplant fruit

Treatment	Water (ml)	CP	EE	CF	CHO	Ca	P	Fe	Ascorbic acid
		←		g /kg		→	←	mg /kg	→
NPK level (kg /ha)									
0	92.11a	0.84c	0.15b	1.81a	4.51b	7.21b	17.66d	1.00b	5.99d
200	82.51d	1.22b	0.48a	1.57b	6.25a	9.18b	19.38c	1.18b	9.24b
300	86.06c	1.38a	0.18b	1.37c	6.37a	14.08a	24.39a	1.42a	10.75a
400	86.69b	1.30ab	0.17b	1.52b	6.54a	14.22a	21.30b	1.64a	8.200c
Age of transplant (weeks)									
5	87.09a	0.96b	0.12c	1.71a	5.55b	11.02a	19.30c	1.26a	6.89c
6	86.92ab	1.29a	0.42a	1.50b	6.300a	11.55a	21.95a	1.36a	9.69a
7	86.52b	1.31a	0.19b	1.49b	5.55b	10.96a	20.79b	1.30a	9.21b
NPK x Age interactions									
5 x 0	96.3	0.43	0.14	2.20	3.4	4.5	16.4	0.90	4.30
5 x 200	82.4	1.24	0.13	1.63	6.9	10.2	18.2	1.06	10.20
5 x 300	84.3	1.10	0.08	1.50	5.7	12.9	24.4	1.30	8.76
5 x 400	85.6	1.08	0.12	1.52	6.4	14.3	18.2	1.79	4.30
6 x 0	87.9	0.99	0.10	1.81	4.8	8.9	16.9	1.04	6.93
6 x 200	85.2	1.14	1.13	1.65	7.6	9.0	19.6	1.37	8.93
6 x 300	88.3	1.62	0.22	1.21	7.0	14.5	26.9	1.62	12.10
6 x 400	86.4	1.42	0.20	1.31	6.9	13.7	24.3	1.200	10.400
7 x 0	92.4	1.09	0.20	1.42	5.3	8.2	19.6	1.06	6.73
7 x 200	400.2	1.33	0.18	1.42	4.2	8.3	20.3	1.10	8.300
7 x 300	85.5	1.43	0.21	1.31	6.4	12.7	21.8	1.32	11.200
7 x 400	88.4	1.200	0.18	1.84	6.3	14.6	21.4	1.72	10.10
LSD (5%):									
N x Age	0.52	0.09	0.06	0.08	0.42	2.66	0.31	0.20	0.25

Means along the same column for each factor are not significantly different using DMRT at 5% probability level.

+ values are average of 2008 and 2010 data