EFFECT OF TRANSPLANTING DATE, PLANT POPULATION AND NITROGEN ON THE GROWTH AND YIELD OF GARDEN EGG (*Solanum gilo* VARIETY WHITE LIGHT

BY

LAMIDO ALIYU

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In partial **fulfilment** of the requirement for the
Degree of Master of Science in Agronomy

DEPARTMENT OF AGRONONY
FACULTY OF AGRICULTURE
AHMADU BELLO UNIVERSITY
ZARIA NIGERIA

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented before in any previous application for a higher degree.

LAMIDO ALIYU
(Candidate)

The above declaration is confirmed.

S.K. KARIKARI
(Major Supervisor)

Date: 20/09/90

CERTIFICATION

This thesis titled "EFFECT OF TRANSPLANTING DATE, PLANT POPULATION AND NITROGEN ON THE GROWTH AND YIELD OF GARDEN EGG (Solanum gilo) VARIETY 'WHITE LIGHT', by Lamido ALIYU meets the regulations governing the degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

MR S.K. KARIKARI
Chairman
Supervisory Committee

PROF M.K. AHMED
Member
Supervisory Committee

DR J.D. OLAREWAJU
Member
Supervisory Committee

DR [illegible] Y. YUSUF
Head,
Department of Agronomy

PROF D.I. SAROR
Dean
Postgraduate School
Date: ..26-1-.91...

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NIGERIA

DEDICATION

To my father, The Late Mallam Aliyu Gwarzo.

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In the name of Allah the Beneficient The Merciful.

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ABSTRACT

An experiment was carried out during 1989 wet season at the Horticultural Field Unit of the Institute for Agricultural Research, Samaru, Zaria, to study the effects of two transplantings dates (5th July 1909 and 26th July 1989), three planting densities (20,000, 40,000 and 60,000 plants/ha) and four nitrogen levels (0, 30, 60 and 90 kg N/ha) on the growth and yield of garden egg.

Transplanting on 5th July 1989 significantly increased number of leaves per plant and fruit diameter while fruit yield per plant, leaf area index and total dry weight per plant were significantly decreased. The rest of the parameters tested were not significantly influenced by transplanting on different dates.

Increasing plant population significantly decreased stem diameter, number of branches per- plant, number of leaves *per* plant, plant leaf spread, leaf dry weight, stem dry weig/nt and total dry weight. Similarly, fruit fresh weight, fruit dry weight and number of fruits were significantly decreased with increase in plant population. Number of leaves per m^2, leaf area index, fruit dry weight per plot and total yield per hectare were however, significantly increased with increase in plant population.

Nitrogen application significantly increased all the growth and yield parameters measured over the control in all the weeks studied. Fruit fresh weight, fruit dry weight per plant. Fruit dry weight per plot and total yield per hectare were progressively increased each additional 30 kg N/ha up to 90 kg N/ha. Total fruit yield per hectare was significantly increased from 4.19 tons in the control to 7.37. 9.98 and 11.55 tons by the application of 30, 60 and 90 kg M/ha respectively which correspond to 76,133 and 175% inoreasa *owr* the control respectively.

Significant interactions were recorded between the factors on most of the parameters tested.

Similarly, significant and positive correlation was obtained between fruit yield nd all parameters tested except number of days to 50%flowering which was negatively correlated with fruit yield.

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Chapter 1

INTRODUCTION

1.1 Origin and Distribution

Garden egg, also known as egg plant, Aubergine, and Brinjal, belongs to the family Solanaceae which also contain several other important economic crops such as tobacco (Nicotiana tabacum), tomato (Lycopersicon esculentum), Irish potato (Solanum tuberosum), the chilli and sweet peppers (Capsicum spp) . It is a member of one of the largest genera of plants (Solanum) with over 1000 species.

The centre of origin of the species has been ascribed by different authors to both the Tropical African and the Indo-Burmese regions. It is widely cultivated in India and is among the highest yielding vegetable crops (Leakey and Wills, 1977). According to Purseglove, (1969), garden egg was first taken into cultivation in India, where wild plants occur. Arabs took it into Spain and Persians to Africa. However, Bhaduri (1951) and Omidiji (1976) opinionated that garden egg possibly evolved independently in different parts of the World.

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1.2 Botany

Garden egg is an annual in temperate zones and perennial in the tropics. Plants grow to a height of 60-120 cm and bear fruits that are spherical to oval in shape. Growth is indeterminate. Oriental cultivars bear more fruits that are

long and slender 15-30 cm long and 4-5 cm in diameter. On maturation the fruits turn orangish-red (Yamaguchi, 1983).

Garden egg develops a moderately extensive root system The main stem of mature plants is woody at the base and is much-branched. The leaves are simple, alternate, large, somewhat angled or lobed. The flowers occur singly or in clusters opposite the leaves. The flowers are perfect, violet, purple or white, and mostly self-pollinated. The fruit is a fleshy ovary varying in size (5-15 cm in diameter), shape (long, ovate or pyriform), and colour (purple, light purple, yellowish, stripped, or white), according to the variety (Edmond et al., 1975).

1.3 Ecological Requirements/Cultural Practices

A warm season crop, garden egg requires continuous long warm weather during growth and fruit maturation. The optimum growing temperature is 22°C - 30°C and growth stops at temperatures below 17°C. Therefore, the night temperature should be warm. Garden egg grows best in well drained light sandy loam. The soil should be slightly acid to slightly alkaline (pH 5.5 - 7.2) (Yamaguchi, 1983).

Garden eggs are grown from seedlings. The seedlings are raised in boxes or nursery beds and later transplanted when they are 4-6 weeks old.

Many of the species are grown all the year round. The garden egg is the most thermophyllic of the solanaceous vegetable crops (Boswell and Jones, 1941). However, most of the production is undertaken in the wet season. The crop is grown in both home gardens using manure and in the fields either alone or interplanted. It is grown on raised beds, ridges or on the sides of heaps carrying yams in the wet season. In the dry season however when moisture conservation is important, the seedlings are planted on the flat or in sunken beds.

The spacing adopted depend on the variety. Big varieties that cover wide areas are spaced wider apart than smaller ones that cover less space.

1.4 Importance and Uses

As a vegetable, garden egg plays a very important role in the human diet, supplying some of the things in which other food materials are deficient. As a commonly grown and eaten vegetable, garden egg is therefore an important source of vitamins and minerals for many Nigerians. It supplements starchy foods in addition to being a cheap source of protein, minerals and vitamins (Oyenuga, 1968; Oyenuga and Fetuga, 1975). Garden egg is also important in neutralizing the acid substances produced in the course of digestion of meats and other substances. It is also of value as roughage, which promotes digestion and helps to prevent constipation.

Nutritional value has been found to be as follows, protein 1.1%, water 93%, fat 0.19%, carbohydrate 4%, vitamin A 70 IU, vitamin B, 0.09mg, vitamin B_2 0.02mg, niacin 0.6mg, vitamin C 7mg, calcium 7 mg, iron 0.4 mg, magnesium 16mg and phosphorus 25 mg per 100 g of edible portion respectively (Howard,1962). A preliminary analysis at IARI of 15 egg plant cultivars for ascorbic acid and protein content indicated variation in ascorbic acid from 14.0 mg/100g to 78.2 mg/100 g dry weight and protein content from 8.45 to 12.70% dry weight (Leakey and Wills , 1977).

The raw fruits can be eaten in both their immature and mature stages. They may also be boiled, fried or stuffed in meats. The fruits of garden egg are edible from the time they are one-third grown until they are ripe. They remain in an edible condition for some time after they become fully grown and coloured (Thompson and Kelly, 1970). A number of species are grown to a limited extent for their leaves (Kogbe, 1981) while others are grown largely for their immature and mature fruits which are chewed raw, cooked as vegetables and also for seasoning other foods (Purseglove, 1969; Tologbonse, 1984). Some species are grown because of their medicinal importance while others like Solanum aviculare are used for the extraction of certain hormones. Among the species, Solanum gilo appears to be the most popular in Nigeria and is widely grown during both the dry and wet seasons, and is used as a source of food and income.

1.5 Objectives of the Study

In view of the importance and use to which garden egg is put to and taking into cognisance the dearth of information on the agronomy of garden egg, the present study was undertaken with the following objectives.

1) To find out the effect of transplanting date, plant population and nitrogen on the growth and yield of garden egg.

2) To study the effect of interaction of the three factors as it affects the growth and yield of garden egg.

Chapter 2

LITERATURE REVIEW

Research on the agronomy of garden egg in the savanna ecological zone of Nigeria has so far been very scanty, especially as regards the optimum transplanting date and plant population that maximise yield. The various studies conducted on the effect of compound fertilizers on garden egg, do not supply adequate information for evaluating the effect of nitrogen on the growth and yield of garden egg. Most of these findingswere inconclusive and contradict one another occasionally. However, they provide ways of understanding the factors that affect the growth and yield of the crop, and also help in the selection of treatments and design.

2.1 Effect of Transplanting Date on the Growth and Yield of Garden Egg

Garden egg is well adapted to both dry and wet season cultivation (Tindall, 1968), and can be cultivated all the year round in most parts of the world wherever a continuous long warm weather is assured during growth and fruit maturatio (Yamaguchi, 1983). However, where sharp differences exist in climatic conditions (rainfall, temperature and shunshine), within or between seasons, growth and yield have been found to be better and higher when transplanting coincides with warm weather and adequate rainfall.

Rylski et al. (1976) examined the effects of different soil temperatures on the development of young egg plant at extreme seasonal air temperature, and found that, rising soil temperature in winter accelerated growth, but lowering soil temperature in summer had no effect, and extremely high soil temperature causes poor plant development. This confirms the findings of Tindall (1968) who observed that the roots of garden egg exhibit sensitivity to high soil temperature and excessive soil water; and Yamaguchi (1983) who reported that transplanting garden egg at temperature below 17°C stops growth. Similarly, Eguchi (1962) studied the effect of different climatic conditions on seed production of egg plant and found that conditions at 8 m above sea level were fairly favourable, but the daily mean temperature at 703 m above sea level was too low for good plant growth.

Fonina (1978) found a direct relationship between the number of days with temperature above 15°C and fruit set and yield. In a 4-year trial, the lowest yield was produced in the cool year, 1976, when maximum fruit set was 9% while the highest yield was produced in the warm year, 1975, when fruit set was 25%. In a similar work, Nothmann et al (1979) found normal growth and flowering in cultivars transplanted during the hot season (May-November), while in the cool season (December - April) growth was slow and fruit quality poor both in size and colour. This agrees with the finding of Nwosah (1970) who

reported higher number and weight of egg plant fruit transplanted during the main wet season (May-July) than in the shorter season (September-November).

Abdel-Al (1973) observed increase in both early and total yield in garden egg and pepper transplanted in mid-August compared with seedlings transplanted in early October. The higher rainfall and warm weather prevailing in August were regarded as the main reasons for such increases in yield. Similarly, Verma et al. (1980) transplanted out garden egg at four different dates between 11th March to 1st April, and reported that the highest yield was obtained from plants transplanted on 25th March. This was corroborated by Hammouda et al. (1982) who transplanted garden egg on several dates between 30th March to 22nd June, and found that early transplanting (between late March and mid-May) gave the highest fruit and seed yields. In all these findings, early transplanting that gave the highest yield coincide with periods of adequate rainfall, warm weather and low incidence of pests and diseases. However, Moschini et al. (1980) reported that overall transplanting on 5th February gave the highest yield when compared with 5th January and 5th March.

2.2 Effect of Plant Population on the Growth and Yield of Garden Egg

The optimum plant population that gives the maximum yield differs between species and varieties under different climatic conditions, resource availability and management practices.

Srinivas and Gupta (1982) reported that commercially produced egg plants are generally grown with a spacing of 75 cm x 50 cm to 6o cm x 40 cm giving a plant population range of 27,000 to 40,000 plants/ha, depending upon the season and plant architecture. They also reported higher yields at higher plant populations. Similarly, Hammouda et al. (1982), Rastogi et al.(1980) and Metwally et al. (1982) obtained the highest yield at plant populations of 47,000; 49,000 and 55,555 plants/ha respectively when compared to lower plant populations. In another trial on papper grown at 3 densities, 27,000; 55,000 and 110,000 plants/ha, yields were reported to increase with plant population and the greatest dry biomass (7.7 tons/ha) was produced at the highest plant population (Strelec and Duda, 1981). Adelana (1976) working on tomato at a range of 10,000 - 40,000 plants/ha recorded the highest yield of fruits from a plant population of 30,000 plants/ha and fruit number declined as plant population increased.

Kogbe (1982) reported significant yield increases in garden egg as spacing decreased. However, when reduced below 60cm x 45cm (above 37,000 plants/ha) yield decreased. This agrees with the findings of Asiegbu and Uzo (1984) who observed increase in yield with increase in plant population, but decreased productivity per plant. However, Ito et al. (1970) declared a spacing of 200cm x 30cm(16,666 plants/ha) to be better for egg plant yield than a closer

or wider spacing. Similarly, Gerardo (1981) did not find any difference in yield attributable to plant densities of 90 cm x 60 cm (18,518 -plants/ha) and 60cm x 60 cm (27,777 plants/ha). Low plant population has also been found to increase yield per plant and better fruit quality (Seth and Dhayder, 1972; Sulikeri ,1977).

2.3 Effect of Nitrogen on the Growth and Yield of Garden Egg

Of all essential nutrients nitrogen exerts the most pronounced effect on plant growth and yield. It promotes vegetative growth, delays maturity and is responsible for the succulent quality of most vegetable crops (Brady, 1978). Several researchers have reported a positive response in egg plant with nitrogen addition in respect of growth and/or yield. This may not be unconnected with the fact that, nitrogen is an essential constituent of eggplant metabolites and chlorophyll necessary for promoting aerial vegetative growth, increasing the top-root ratio and essential for fruit and seed formation (Olson et al. 1971).

Takahachi et al. (1979) reported that, at similar light levels, plants receiving high nitrogen levels grew faster, produced flower buds earlier and had a larger number of flowers than plants receiving low nitrogen levels. Similarly, the highest fruit set (29.1%) and largest plants were obtained

with nitrogen at 50 kg N as a basal dressing plus 25 kg N/ha as 1% urea foliar spray as from transplanting plus a further 25 kg N/ha as 1% urea applied as from flowering (Rajeeven and Rao, 1980). However, Addae-Kagya and Norman (1977) reported that the effect of nitrogen levels on flowering, fruit set and yield was not significant, although application of 89 kg N/ha greatly increased vegetative growth of the plants.

Garden egg has also been reported to respond well to 70 kg N/ha in respect of both fruit and seed yield (Seth and Dhauder, 1972); 100mg N/kg dry soil in respect of fruit dry matter, sugar content and vitamin C (Alieva, 1973); 80 kg N/ha in respect of total yield (Sulikeri, 1977) and 140 kg N/ha in respect of marketable yield (Chakraborty et al., 1974). Nitrogen application has also been found to increase plant height, number of branches, number of leaves and that total yield/ha increased significantly up to 150 kg N/ha (Ezeakunne, 1985). Similarly, number of fruits and weights of fruits per plot have been observed to increase with rising nitrogen up to 200 kg/ha (Kalyana Sundaram and Sambandam, 1979). However, Gupta et al. (1978) and Kogbe (1982) reported that yield of egg plant increased significantly with increase in nitrogen up to 100 kg N/ha but declined at 150 kg N/ha, though Gupta et al (1978) did not detect such depression in yield at 150 kg N/ha.

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Nitrogen application has also been observed to increase number of branches per plant (Singh and Sandhu, 1970; and Gill et al. 1974), dry matter production (Seth and Dhauder, 1972; and Doikova, 1977) plant height, leaf area index and stem diameter (Singh and Sandhu, 1970) and early flowering (Verma et al., 1970). Doikova (1978) also reported that nitrogen fertilizers have significantly raised the yield of egg plant by 52%.

2.4 Effect of Interaction between Transplanting Date, Plant Population and Nitrogen levels on Garden egg

Garden egg transplanted under favourable environmental conditions (warm weather, adequate rainfall and sunshine) have been found to make better use of available nutrients and inter-plant competition minimized thus enabling the adoption of higher plant population. However, increasing the plant population will increase the inter-plant competition thereby necessitating the application of higher levels of nutrients to sustain maximum yields.

Rajput (1968) studied the effect of plant population and time of transplanting on growth and yield of garden egg, and he found that interaction between number of plants and time of transplanting had significant effects on growth and yield. Gerardo (1981) found that at 18,918 plants/ha, egg plant showed a gradual response to nitrogen with each increment of 112 kg

N/ha up to 450 kg N/ha. Whereas at a plant population of 27,777 plants/ha, a slight decrease in yield was observed with the application of 450 kg N/ha. However, Kogbe (1982) did not detect any interaction between nitrogen and plant population, although each separately increased yield. Similarly, interaction between nitrogen and plant population was not significant on growth and yield parameters of pepper (Ramachandran and Subbiah, 1981; Rastogi et al., 1980). Interaction was not detected also between transplanting date and plant population on performance of garden egg, although each treatment had significant effect on the yield of garden egg (Hammouda et al., 1982).

Chapter 3

MATERIALS AND METHODS

3.1 Experimental Site

The experiment was conducted at the Horticultural Field Unit of the Institute for Agricultural Research, Ahmadu Bello University, Samaru Zaria, during 1989 wet season. The site is located at approximately 11° 10'N, 07° 35'E and 686 m above sea level in the Northern Guinea Savanna ecological zone of Nigeria. Sweet potato, chilli pepper and winged bean were grown at the site during the previous season.

The soil of the experimental site is a loam, described as well drained often leached ferrugineous tropical soil (D'Hoore, 1964; Klinkenberg and Higgins, 1968). It is characterized by low pH, low cation exchange capacity, low organic carbon and nitrogen but with high level of potassium.

Total rainfall at Samaru in 1989 was 751.8 mm and it was fairly distributed throughout the growing season. Details of the physico-chemical analysis of the soil and weather conditions during the period of the experiment are shown in Tables 1 and 2, respectively.

Table 1 Physico-chemical properties of the soil of the experimental site taken at two depths during 1989 wet season at Samaru

Soil property	Soil Depth (cm)	
	0-15	15-30
Particle size distribution		
Clay (%)	10	14
Silt (%)	42	40
Sand (%)	48	46
Textural class	Loam	Loam
pH 1:2:5		
Water	5.70	5.90
0.01M $CaCl_2$	4.80	5.00
Organic carbon (%)	0.38	0.46
Available phosphorus (ppm)	13.42	15.02
Total Nitrogen (%)	0.04	0.05
Exchangeable bases (meq/100g soil)		
Ca	1.06	1.18
Mg	0.38	0.41
K	0.27	0.30
Na	0.10	0.10
C.E.C.	6.20	6.40

3.2 Treatments and Experimental Design

Treatments consisting of factorial combinations of two transplanting dates (5th July 1989 and 26th July 1989), three plant populations (20,000; 40,000 and 60,000 plants/ha) and four nitrogen levels (0, 30, 60 and 90 kg N/ha) were tested. This gave a total of 24 (2x3x4) treatment combinations which were replicated three times and laid out in a split plot design. Transplanting date was randomly allocated to the main plots while the combination of plant population and nitrogen were randomized and assigned to the subplots.

3.3 Cultural Practices

3.3.1 Nursery management

The nursery plot was thoroughly pulverised to produce a fine tilth and several beds measuring $2m^2$ were prepared on 25th May 1989 and later on 15th June 1989. On each date healthy seeds of *Solanum gilo* var. "White light" were drilled on the beds in rows 15 cm apart. The beds were then mulched and heavily watered. The mulch was subsequently removed after the seeds have germinated. The seedlings were regularly watered and kept weed free till the time of transplanting.

3.3.2 Site preparation

The experimental site was ploughed once and harrowed twice. The site was then divided into replications, each replicate was then demarcated into main and subplots. The

subplots were built into raised flat beds of size 2 x 3.75 m ($7.5m^2$).

3.3.3 Transplanting

Seedlings planted on 25th May 1989 were transplanted out to the field on 5th July 1989 while those planted on 15th June 1989 were transplanted out on 26th July 1989. In each case the transplanting was done very early in the morning and only healthy and uniform sized seedlings were transplanted. Plant spacings utilized to achieve the required plant populations are 75 x 66.66 cm, 75 x 33,33cm and 75 x 22,22cm for 20,000; 40,000; and 60,000 plants/ha, respectively.

3.3.4 Fertilizer application

The nitrogen fertilizer used in the experiment was applied in two equal split doses in grooves 5cm deep and 5cm away from each plant as per treatment. The first dose was applied two weeks after transplanting while the second dose was applied six weeks after transplanting. In addition to the nitrogen treatments, each plot received a blanket application of phosphorus (P_2O_5) and potassium (K_2O) at the rates of 60 kg and 30 kg per hectare respectively. The phosphorus and potassium fertilizers were broadcasted at the time of site preparation. The sources used are calcium ammonium nitrate (26% N) for nitrogen; Single superphosphate (18% P_2O_5) for phosphorus; and muriate of potash (60% K_2O) for potassium).

3.3.5 Weed and pest control

Weeds were controlled by hoeing which was started from 2 weeks after transplanting and continued at biweekly intervals till about 10 weeks after transplanting when the foliage cover of the crop was dense enough to smother competing weeds.

The crop was sprayed fortnightly with cypermethrin at the rate of 50ml in 10 litres of water per hectare using a CP-3 knapsack sprayer for the control of insects and their larvae. Spraying was terminated a week before harvest.

3.3.6 Harvesting

Mature fruits were harvested fornightly starting from seven weeks after transplanting. Harvesting continued till thirteenth week after transplanting when the plants have stopped flowering and the remaining fruits have ripened.

3.4 Data Collection

3.4.1 Meteorological data

Data on rainfall distribution, maximum and minimum temperature readings, sunshine hours and relative humidity at Samaru during 1989 wet season were obtained from the Meteorological Station, IAR, Samaru.

Table 2: Total rainfall, maximum and minimum temperature, relative humidity and sunshine hours at ten day interval during the period of the experiment at Samaru in 1989 wet season.

Month	Days	Total rainfall (cm)	Temperature (°C) max.	min.	Relative Humidity (%) a.m.	p.m.	Sunshine (hours)
May	1-10	39.3	32.0	20.2	63.8	48.3	5.88
	11-20	20.5	33.0	20.5	57.6	37.3	7.70
	21-31	52.2	34.2	20.4	63.7	45.7	9.47
June	1-10	55.4	31.9	20.8	70.6	55.2	7.84
	11-20	21.0	31.9	20.5	69.0	54.0	8.52
	21-30	48.0	28.4	18.7	79.8	64.9	6.07
July	1-10	26.9	30.9	20.0	84.0	63.6	7.95
	11-20	31.5	28.9	19.4	80.9	59.5	6.35
	21-31	101.3	29.4	19.7	81.9	66.6	5.76
August	1-10	55.1	27.4	19.5	82.4	70.6	4.27
	11-20	28.9	28.8	19.4	81.3	69.7	6.45
	21-31	85.5	28.5	19.1	81.4	67.0	5.62
Sept	1-10	70.7	28.6	19.1	81.7	70.6	5.31
	11-20	29.9	30.1	19.2	77.8	65.3	6.91
	21-30	9.7	30.7	19.2	75.6±	64.7	7.10
Oct.	1-10	51.9	30.9	19.3	74.9	63.5	7.51
	11-20	1.0	30.7	17.8	61.7	43.2	8.11
	21-31	Nil	31.2	12.7	42.1	22.4	9.09

Source. Meteorological Unit, Insitute for Agricultural Research, Samaru, Zaria, Nigeria.

3.4.2 Soil analysis

Soil samples were randomly taken from two soil depths (0-15 and 15-30 cm) from different locations at the experimental site using a tubular auger. The soil samples were taken after ploughing and harrowing but before fertilizer application, bulked and analysed for physical and chemical properties.

The texture was analysed by the Hydrometer method (Boyoucos, 1951) and the textural class determined by the soil texture triangle. Total nitrogen was determined by the macro-Kjeldhal procedure (Bremner, 1965;) and available phosphorus by the method described by Troug (1930). Exchangeable cations were determined by the acetic acid method (Reith, 1967). pH and organic carbon were determined using the standard procedures described by Black (1965).

3.4.3 Assessment of Growth characters

For the assessment of growth characters, random sample of six plants was selected from each plot and tagged. Observations on growth parameters were conducted on the tagged plants at biweekly intervals beginning from the third week after transplanting. Plant height was found by measuring the height of each tagged plant from ground level to the tip of the terminal bud. Number of leaves per plant was found by counting the total leaves on each tagged plant

while the number of leaves per m² was found by calculating the number of leaves in an area of 1 m^2. Number of branches per plant was also found by counting the main and primary branches on each of the tagged plants. Stem diameter was determined by measuring the stem girth of each tagged plant at ground level with a caliper. Plant leaf - spread (canopy spread) was determined by laying a ruler across the distal ends of opened foliage and measuring the distance between them.

Leaf area index (LAI) was determined by the method described by Watson (1958). Two plants were randomly chosen from the outer rows and removed. Their leaves were then detached and piled one on top of the other. A cork borer with a diameter of 1.25 cm was run through the pile of leaves so that leaf discs were formed. The number of complete discs was counted and recorded. The discs with remaining leaves were then oven dried to a constant weight at a temperature of 70°C. The leaf discs and the remaining leaves were weighed separately and the weight recorded. Average disc weight was determined by dividing the total leaf disc weight by the number of leaf discs. Leaf area of the sample was then calculated using the following equation:

$$\text{Leaf area} = \frac{X + Y}{Z} \times P$$

Where x = weight of the leaf disc in grams

y = weight of the remaining leaves in the sample in grams

Z = average disc weight in grams

P = disc area in cm^2

This was then used to calculate the leaf area index as follows:

$$\text{Leaf area index} = \frac{\text{Leaf area in } cm^2}{\text{Ground area}}$$

3.4.4 Yield and yield-related characters

Fruit yield per plant was determined by finding the fresh fruit weight of total fruits harvested from all tagged plants and dividing by the number of tagged plants. Number of fruits per plant was found by determining the average number of fruits harvested from the tagged plants. Fruit diameter was determined by measuring the diameter of fruits from tagged plants of each plot with a caliper. Leaf and stem dry matter was determined by harvesting two plants from the outer rows and separating each into leaf, stem and others (flowers buds and fruits). These were then oven dried to constant weight at a temperature of 70°C. The separate weights were then recorded. Total dry weight per plant was found by pooling all dry weight from the harvested plants.

Similarly, fruit dry weight per plant was determined by oven-drying harvested fruits to constant weight at a temperature of 70°C, while fruit dry weight per plot was determined by finding the average dry weight of fruits per plant and multiplying by the total number of plants in that plot.

Number of days to 50% flowering was determined by recording the number of days when 50% of the plants in each plot have reached anthesis. The total nitrogen content of fruits was determined using Macro-Kjeldahl procedure. The values were then converted into percent crude protein.

3.5 Statistical Analysis of Data

An analysis of variance was carried out to test for significance in the treatment effects using the F'test as described by Snedecor and Cochran (1967). Where the F test is significant, Duncan Multiple Range Test (Duncan, 1955) was used to evaluate differences among treatment means. Correlation study was also carried out between fruit yield and other characters to find the presence of and or the degree of their association. Regression analysis was also conducted to determine the yield response of garden egg to plant population and nitrogen.

Chapter 4

RESULTS

4.1 General Observation

Crop growth and performance was generally good throughout the period of experiment, although senescence set in at 12 weeks after transplanting.

A slight incidence of Cercospora leaf spot was observed. Limited attempt was made to control the disease as it occured very late in the season and only few plants were affected and these are consequently removed and destroyed.

4.2 Effect of Transplanting Date, Plant Population and Nitrogen on the Growth of Garden Egg

4.2.1 Plant height

There was no significant difference in plant height due to transplanting date and plant population in all the weeks tested. Nitrogen application however, significantly increased plant height over the control (Table 3).

Application of nitrogen significantly increased plant height over the control, however, there was no significant difference in plant height due to the different nitrogen levels at 3 and 5 weeks after transplanting (WAT). Application of 90 kg N/ha significantly increased plant height compared with 30 kg N/ha in the remaining weeks studied. There was no

Table 3 Effect of transplanting date, plant population and nitrogen on the height of garden egg (cm) during 1989 wet season at Samaru

Treatment	Weeks after Transplanting 3	5	7	9	11
Transplanting date					
5-7-1989	11.00	29.50	50.43	55.34	64.19
26-7-1989	6.56	23.30	50.23	55.33	57.73
SE ±	2.350	3.050	2 480	1.110	1.430
Plant population (plants/ha)					
20,000	8.46	24.63	51 84	56.51	62.54
40,000	8.70	26.98	49.28	53.54	57.87
60,000	9.17	27.59	49.86	55.94	58.99
SE ±	0.450	1.140	1.710	1.780	1.750
Nitrogen (kg/ N/ha)					
0	6.93b	18.22b	35.22c	38.74c	42.14c
30	9.09a	28.39a	51.15b	55.81b	61.90b
60	9.04a	29.32a	55.72ab	62.32a	68.55a
90	10.06a	29.67a	59.22a	64.46a	70.26a
SE ±	0.520	1.310	1.980	2.050	2.030
Interactions					
DxP	NS	NS	NS	NS	NS
DxN	NS	NS	NS	NS	NS
PxN	NS	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.
NS = not significant

difference in plant height between 60 kg N/ha and 90 kg N/ha were at par statistically at 7 WAT, difference between them was however significant at 9 and 11 WAT.

and 30 and 60 kg N/ha

No significant interaction was recorded between the three factors on plant height.

4.2.2 Number of branches per plant

Data on the effect of transplanting date, plant population and nitrogen on the number of branches of garden egg recorded at 3, 5, 7, 9 and 11 WAT are shown on Table 4a.

Number of branches produced by garden agg plant were not influenced significantly by transplanting on different dates in all the weeks tested.

Similarly, plant population did not significantly affect the number of branches produced by garden egg at 5, 7 and 9 WAT. However, increasing the plant population from 20,000 to 40,000 plants/ha significantly increased number of branches at 3 WAT, while decreasing the number of branches at 11 WAT. In both weeks, 40 and 60,000 plants/ha were at par statistically.

Nitrogen application increased number of branches per plant significantly over the control in all the weeks studied. There was no significant difference in number of branches between the various levels of nitrogen at 3 WAT. Application of 90 kg N/ha produced the highest number o

branches, followed by 60 kg N/ha which was also significantly higher than 30 kg N/ha at 5 and 7 WAT. However, application of 90 kg N/ha did not significantly increase number of branches over 60 kg N/ha but the two levels produced significantly more branches than 30 kg N/ha at 9 and 11 WAT.

A significant interaction was recorded between transplanting date and plant population at 3 WAT (Table 4b). When the same plant population was compared at different dates, it was observed that, early planting resulted in significantly higher branches than late planting. When the same transplanting date was compared at varying plant population, on 5th July 1989, 20,000 plants/ha produced significantly lower number of branches than either 40 or 60,000 plants/ha. The difference between 40 and 60,000 plants/ha was not significant statistically. On 26th July 1989, the three populations did not produce significantly different number of branches.

A significant interaction was also observed between transplanting date and nitrogen at 5 WAT (Table 4c). When the same nitrogen level was compared at different dates, early transplanting produced significantly more number of branches than late transplanting except at 0 kg N/ha when the two dates were at par statistically. When the same transplanting date was compared at varying nitrogen levels, 60 and 90 kg N/ha did not produced significantly different number of branches, but the two produced significantly more

Table 4a Effect of transplanting date, plant population and nitrogen on number of branches produced by garden egg plant during 1989 wet season at Samaru.

Treatment	Weeks After transplanting				
	3	5	7	9	11
Transplanting date					
5-7-1989	3.65	7.49	9.17	10.18	10.06
26-7-89	0.94	5.55	8.92	9.27	10.32
SE ±	0.490	0.560	0.710	0.960	0.590
Plant Population (plants/ha)					
20,000	1.88b	6.42	9.67	10.79	11.55a
40,000	2.43a	6.44	8.66	9.66	9.73b
60,000	2.97a	6.71	8.30	9.66	9.23b
SE ±	0.170	0.210	0.340	0.390	0.400
Nitrogen (kg N/ha)					
0	1.36b	3.92d	6.17d	6.83c	7.34c
30	2.50a	6.39c	8.13c	9.14b	9.57b
60	2.71a	7.53b	10.37b	11.36a	11.49a
90	2.61a	8.25a	11.51a	12.76a	12.36a
SE ±	0.200	0.250	0.390	0.450	0.460
Interactions					
DxP	*	NS	NS	NS	NS
DxN	NS	*	NS	NS	NS
PxN	NS	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.
* = significant.

Table 4b Number of branches of garden egg at 3 WAT as influenced by transplanting date x plant population interaction during 1989 wet season at Samaru.

Treatment	Transplanting Date	
	5-7-1989	26-7-1989
Plant population (plants/ha)		
20,000	2.79b	0.98c
40,000	3.92a	0.94c
60,000	4.25a	0.90c
SE ± 0.240		

Interaction means followed by unlike letters are significantly different at 5% level of significance using DMRT.

number of branches than 0 kg N/ha on 5th July 1989. On the second date, application of 60 kg N/ha did not produce more number of branches than 30 kg N/ha but the two significantly produced more numbers of branches than 0 kg N/ha and less number of branches than 90 kg N/ha.

Table 4c Number of branches of garden egg at 5 WAT as influenced by transplanting date x nitrogen interaction during 1989 wet season at Samaru.

Treatment	Transplanting Date	
	5-7-1989	26-7-1989
Nitrogen (kg N/ha)		
0	4.39d	3.44d
30	7.14b	5.64c
60	9.00a	6.06c
90	9.44a	7.06b
SE ± 0.350		

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

4.2.3 Number of leaves per plant

Result of the effect of transplanting date, plant population and nitrogen on the number of leaves produced by garden egg plant is presented on Table 5a.

Number of leaves per plant were not significantly influenced by transplanting date at 3, 7 and 9 WAT. Transplanting on 5th July 1989 produced significantly more number of leaves than transplanting on 26 July 1989 at 5 and 11 WAT.

There was no significant difference in number of leaves produced per plant when plant population was increased from 20 to 40,000 plants/ha at 3, 7 and 11 WAT. However, increasing the plant population to 60,000 plants/ha significantly reduced number of leaves when compared with 20,000 plants/ha at 7 and 9 WAT while it was increased at 3 WAT. There was no difference between 40 and 60,000 plants/ha in all the weeks tested, and the two levels produced significantly less number of leaves than 20,000 plants/ha at 9 WAT. Similarly, there was no difference between the three populations at 5 WAT.

Application of nitrogen produced significantly more leaves than the control in all the weeks tested. Application of 90 kg N/ha produced significantly more leaves than 60 kg N/ha only at 9 WAT. The two levels produced significantly more leaves than 30 kg N/ha at 3, 7, 9 and 11 WAT. At 5 WAT, application of 30 kg N/ha was at par with 60 kg N/ha but produced significantly fewer leaves than 90 kg N/ha.

A significant interaction between transplanting date and plant population was recorded at 3 WAT (Table 5b). When the same plant population was compared at different dates, number of leaves per plant was significantly increased by transplanting early. When varying population levels were compared at the same date, it was found that, increasing plant population produced significantly higher number of leaves on 5th July 1989. However, number of leaves were not significantly affected by different population densities on 26th July 1989.

Table 5a Effect of transplanting date, plant population and nitrogen on the number of leaves produced by garden egg during 1989 wet season at Samaru.

Treatment	Weeks After Transplanting 3	5	7	9	11
Transplanting date					
5-7-1989	14.03	37.20a	51.87	79.30	80.66a
26-7-1989	7.94	29.47b	62.09	66.52	69.81b
SE ±	2.630	0.780	3.370	4.920	1.490
Plant population (plants/ha)					
20,000	9.80b	34.45	61.45a	81.84a	87.42a
40,000	11.06ab	32.60	55.23ab	69.91b	71.68ab
60,000	12.09a	33.10	54.27b	60.97b	66.61b
SE ±	0.520	1.140	2.320	3.400	2.730
Nitrogen (kg N/ha)					
0	7.92c	22.60c	39.07c	45.85d	52.29c
30	10.90b	33.71b	52.21b	60.29c	68.03b
60	12.82a	37.04ab	65.39a	80.58b	88.24a
90	12.31a	40.19a	71.26a	96.90a	92.40a
SE ±	0.600	1.320	2.680	3.930	3.150
Interactions					
DxP	*	NS	NS	NS	NS
DxN	NS	NS	NS	NS	NS
PxN	NS	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

4.2.4 Number of leaves per m²

Table 6a shows the effect of transplanting date, plant population and nitrogen on the number of leaves per m² of garden egg.

Changes in date of transplanting had no significant influence on the number of leaves per m² of garden egg.

Increasing plant population significantly increased number of leaves per m² of garden egg. 60,000 plants/ha produced the highest number of leaves per m² followed by 40,000 plants/ha which also produced significantly the higher number of leaves/m² when compared with 20,000 plants/ha.

Number of leaves/m² was significantly increased by the application of 30 kg N/ha over the control in all the weeks studied. Application of 60 and 90 kg N/ha produced significantly more leaves/m² than 30 and 0 kg N/ha at 7, 9 and 11 WAT. However, the difference between 60 and 90 kg N/ha was not significant at 7 and 11 WAT. Similarly, there was no difference between the nitrogen levels at 3 and 5 WAT.

Interaction between transplanting date and plant population significantly affected number of leaves/m² at 3 and 5 WAT (Table 6b). When the same population was compared at different dates, it was found that transplanting early increased number of leaves/m² at 40 and 60,000 plants/ha whereas the difference

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Table 5b Interaction between transplanting date and plant population as it affects the number of leaves of garden egg at 3 WAT during 1989 wet season at Samaru.

	Transplanting Date	
Treatment	5-7-1989	26-7-1989
Plant population (plants/ha)		
20,000	11.62c	7.98d
40,000	14.17b	7.96d
60,000	16.31a	7.87d
SE ± 0.730		

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

between the two dates was not significant at 20,000 plants/ha in both weeks. When the different population densities were compared at each date, it was observed that increasing plant population significantly increased number of leaves/m^2 on each date and in both weeks.

A significant interaction was also observed between plant population and nitrogen at 3, 5 and 9 WAT (Table 6c). When the same nitrogen level was compared at different transplanting dates, it was found that increasing the plant population resulted in significantly higher number of leaves/m^2 in all the weeks.

Table 6a Number of leaves per m² of garden egg as influenced by transplanting date, plant population and nitrogen during 1989 wet season at Samaru.

Treatment	Weeks after transplanting 3	5	7	9	11
Transplanting date					
5-7-1989	59.29	149.25	204.64	281.51	308.28
26-7-1989	31.61	116.56	241.69	257.97	270.43
SE ±	11.460	16.04	16.65	22.16	17.70
Plant population (plants/ha)					
20,000	19.63c	68.00c	122.91c	163.71c	186.79c
40,000	44.17b	132.09b	220.93b	279.67b	301.55b
60,000	72.56a	190.63a	325.65a	365.85a	379.70a
SE ±	2.930	5.640	10.25	14.32	17.96
Nitrogen (kg N/ha)					
0	31.53b	88.11b	151.32c	170.13d	193.35c
30	45.39a	135.73a	206.20b	230.52c	260.64b
60	53.36a	150.75a	257.19a	305.78b	336.80a
90	51.53a	157.03a	277.95a	372.54a	366.54a
SE ±	3.38	6.510	11.87	16.54	20.73
Interactions					
DxP	*	*	NS	NS	NS
DxN	NS	NS	NS	NS	NS
PxN	*	*	NS	*	NS
DxPxN	NS	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of signficance using DMRT.

Table 6b Interaction between transplanting date and plant population as it affects the number of leaves/m² at 3 and 5 WAT during 1989 wet season at Samaru.

Treatment	Weeks After Transplanting			
	3		5	
Transplanting date				
	5-7-1989	26-7-1989	5-7-1989	26-7-1989
Plant population (plants/ha)				
20,000	23.33cd	15.92d	74.25e	61.75e
40,000	56.67b	31.67c	146.000c	118.17d
60,000	97.87a	47.25b	227.50a	169.77b
SE ±	4.140		7.970	

Interaction means within a week followed by unlike letter(s) are significantly different at 5% level using DMRT.

Table 6c Interaction between plant population and nitrogen as it affects the number of leav s/m^2 of ga egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting								
	3			5			9		
Plant population (plants/ha)									
	20,000	40,000	60,000	20,000	40,000	60,000	20,000	40,000	60,000
Nitrogen (kg N/ha)									
0	14.58d	37.50bcd	42.50bc	52.50f	94.83de	117.00d	109.93f	190.43def	210.02d
30	19.58cd	42.33bc	74.25a	63.75ef	134.17bc	209.26a	138.10f	235.17d	318.28c
60	23.00cd	48.33b	88.75a	72.08ef	140.67b	239.51a	184.86def	327.20bc	405.29b
90	21.33cd	48.50b	84.75a	83.67ef	158.67b	228.76a	221.94d	365.88bc	529.79a
SE ±		8.290			11.270			28.540	

Interaction means within a week followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

When the same plant population was considered at varying nitrogen levels, same number of leaves/m² was produced on application of 30, 60 and 90 kg N/ha at each plant population at 3 and 5 WAT. The 3 levels however, produced significantly more leaves/m² over the control at 60,000 plants/ha at 3, 5 and 9 WAT, and at 40,000 plants/ha at 5 WAT.

4.2.5 Plant leaf spread

Table 7 shows the effect of transplanting date, plant population and nitrogen on leaf spread of garden egg at 9 WAT. Transplanting date did not significantly influence the leaf spread of garden egg.

Increasing plant population from 20 to 40,000 plants/ha significantly decreased plant leaf spread. However, a further increase in plant population to 60,000 plants/ha had no significant effect on leaf spread of garden egg.

Leaf spread was significantly increased by the application of 30 kg N/ha over the control. 30 kg N/ha however produced significantly lower leaf spread than 60 and 90 kg N/ha which are statistically at par.

There was no significant interaction between the factors on plant leaf spread.

Table 7 Effect of transplanting date, plant population and nitrogen on plant leaf spread (cm) of garden egg at 9 WAT during 1989 wet season at Samaru.

Treatment	Plant leaf spread (cm)
Transplanting date	
5-7-1989	74.21
26-7-1989	76.24
SE ±	7.000
Plant population (plants/ha)	
20,000	83.24a
40,000	72.45b
60,000	70.00b
SE ±	2.850
Nitrogen (kg N/ha)	
0	55.83c
30	65.21b
60	92.20a
90	88.69a
SE ±	3.060
Interactions	
DxP	NS
DxN	NS
PxN	NS
DxPxN	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

4.2.6 Leaf area index

Leaf area index was not significantly influenced by transplanting on different dates at 6, 8 and 12 WAT (Table 8a). Transplanting on 26th July 1989 however increased leaf area index over transplanting on 5th July 1989 at 10 WAT.

Leaf area index increased significantly with each additional 20,000 plants/ha upto 60,000 plants/ha at 3 WAT. There was no difference between 20 and 40,000 plants/ha at 8 WAT, but the two levels produced significantly lower leaf area index than 60,000 plants/ha. Similarly at 10 WAT there was no difference between 40 and 60,000 plants/ha but the two levels produced significantly greater leaf area index than 20,000 plants/ha. There was no difference between the three levels at 12 WAT.

Application of 30 kg N/ha produced significantly higher leaf area index than 0 kg N/ha in all the weeks studied and significantly lower leaf area index than 90 kg N/ha in all weeks tested. There was no difference between 30 and 60 kg N/ha at 6, 8 and 12 WAT. Similarly there was no difference between 60 and 90 kg N/ha at 10 WAT.

Leaf area index was significantly affected by an interaction between plant population and nitrogen at 12 WAT (Table 8b). When varying nitrogen levels were compared at same plant population, it was observed that application of 90 kg N/ha produced significantly the highest leaf area index over other levels at 60,000 plants/ha.

Table 8a Effect of transplanting date, plant population and nitrogen on leaf area index of garden egg during 1989 wet season at Samaru.

	Weeks after transplanting			
Treatment	6	8	10	12
Transplanting date				
5-7-1989	0.96	2.20	2.24b	1.70
26-7-1989	1.11	3.04	3.16a	1.92
SE ±	0.230	0.420	0.130	0.390
Plant population (plants/ha)				
20,000	0.65c	2.02b	2.09b	1.65
40,000	1.05b	2.52b	2.91a	1.71
60,000	1.41a	3.32a	3.11a	2.08
SE ±	0.100	0.250	0.250	0.150
Nitrogen (kg N/ha)				
0	0.37c	1.33c	1.50c	1.00c
30	0.94b	2.29b	2.16b	1.53b
60	1.19b	2.75b	3.34a	1.81b
90	1.64a	4.13a	3.80a	2.92a
SE ±	0.120	0.290	0.270	0.180
Interactions				
DxP	NS	NS	NS	
DxN	NS	NS	NS	NS
PxN	NS	NS	NS	*
DxPxN	NS	NS	NS	*

Means in a column of any set of treatment followed by unlike latter(s) are significantly different at 5% level of significance using DMRT.

The difference between the nitrogen levels was also not significant at 40,000 plants/ha. .a. At 20,000 plants/ha, there was no difference between 60 and 90 kg N/ha, but the two levels produced significantly higher leaf area index than 0 kg N/ha. There was also no difference between 30 and 60 kg N/ha.

A second order interaction involving the three treatments was also recorded at 12 WAT (Table 8c). The highest index was produced at a plant population of 60,000 plants/ha in combination with 90 kg N/ha when plants were transplanted on 5th July 1989.

Table 8b Interaction between plant population and nitrogen as it affects leaf area index of garden egg at 12 WAT during 1989 wet season at Samaru.

Treatments	Plant Population (plants/ha)		
	20,000	40,000	60,000
Nitrogen (kg N/ha)			
0	0.77a	1.07de	1.14de
30	1.22de	1.84bcd	1.53de
60	1.91bcd	1.79cd	1.72cd
90	2.68b	2.15bc	3.93a
SE ± 0.300			

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 8c Interaction between transplanting date, plant population and nitrogen as it affects the leaf area index of garden egg at 12 WAT during 1989 wet season at Samaru.

Treatment						
Transplanting date	5-7-1989	5-7-1989	5-7-1989	26-7-1989	26-7-1989	26-7-2989
Plant population (plants/ha)	20,000	40,000	60,000	20,000	40,000	60,000
Nitrogen (kg N/ha)						
0	0.57e	1.05de	1.67b-e	0.97de	1.10de	1.11de
30	1.16de	2.00b-e	1.28cde	1.28cde	1.68b-e	1.78b-e
60	1.90b-e	1.27cde	1.32cde	1.92b-e	2.31bcd	2.11bcd
90	2.69bc	1.27cde	4.76a	2.67bc	3.04b	3.10b
SE ± 0.430						

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

4.2.7 Stem diameter

The effect of transplanting date, plant population and nitrogen on the stem diameter is shown on Table 9a. Stem diameter was not significantly affected by transplanting date in all the weeks tested.

Increasing the plant population from 20 to 40,000 plants/ha significantly reduced stem diameter. However, there was no difference between 40 and 60,000 plants/ha in all the weeks studied.

Stem diameter was significantly increased by the addition of 30 kg N/ha up to 90 kg N/ha at which the thickest girth was produced at 7, 9 and 11 WAT. There was no difference between 60 and 90 kg N/ha at 5 WAT, but the two levels produced signficantly thicker stem than 30 kg N/ha which also produced significantly thicker stem than 0 kg N/ha.

Significant interactions between transplanting date and nitrogen was observed at 7, 9 and 11 WAT (Table 9b). When the same date was compared at different nitrogen level, it was found that late transplanting produced significantly thicker stems when 90 kg N/ha was applied at 7, 9 and 11 WAT. The difference between the two dates was not significant at other levels except 90 kg N/ha at 7 and 9 WAT. However, early transplanting produced significantly thicker stems than late planting at each nitrogen level except 90 kg N/ha at 11 WAT. When different nitrogen levels were compared at the same date, the difference

Table 9a Effect of transplanting date, plant population and nitrogen on the stem diameter (cm) of garden egg during (1989 wet season at Samaru.

Treatments	Weeks after transplanting			
	5	7	9	11
Transplanting date				
5-7-1989	1.23	1.49	1.51	1.70
26-7-1989	1.23	1.51	1.58	1.61
SE ±	0.001	0.250	0.050	0.040
Plant population (plants/ha)				
20,000	1.33a	1.56a	1.60a	1.79a
40,000	1.22b	1.46b	1.52b	1.63b
60,000	1.15b	1.43b	1.51b	1.59b
SE ±	0.30	0.030	0.030	0.030
Nitrogen (kg N/ha)				
0	0.94c	1.14d	1.20d	1.31d
30	1.20b	1.38c	1.46c	1.54c
60	1.36a	1.65b	1.69b	1.83b
90	1.43a	1.75a	1.83a	1.95a
SE ±	0.040	0.030	0.040	0.040
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	*	*	*
PxN	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

between the various levels was significant at 26th July 1989 in all the weeks. However, there was no difference between 60 and 90 kg N/ha on 5th July 1989 at 7 and 9 WAT. The two levels were higher than 30 and 0 kg N/ha at 7 and 11 WAT. The difference between 30 and 60 kg N/ha was not significant at 9 WAT.

4.2.8 Leaf dry weight

Table 10a shows the effect of transplanting date, plant population and nitrogen on the leaf dry weight of garden egg recorded at biweekly intervals.

Leaf dry weight was not significantly affected by transplanting on different dates in all the weeks studied.

Increasing plant population from 20,000 to 40,000 plants/ha significantly decreased leaf dry weight in all the weeks studied. Further increase to 60,000 plants/ha decreased leaf dry weight only at 10 WAT. In other weeks, there was no difference between 40 and 60,000 plants/ha.

Application of 30 kg N/ha significantly produced heavier dry leaves than 0 kg N/ha in all the weeks tested, but lighter dry leaves than 60 kg N/ha at 10 and 12 WAT. Heaviest dry leaves were produced on application of 90 kg N/ha which was significantly higher than all other levels. There was no difference between 30 and 60 kg N/ha at 6 and 8 WAT.

A significant interaction was recorded between transplanting date and plant population at 6 and 12 WAT (Table 10b). When the

Table 9b Transplanting date x nitrogen interaction as it affects the stem diameter (cm) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after Transplanting					
	7		9		11	
Transplanting date						
	5-7-1989	26-7-1989	5-7-1989	26-7-1989	5-7-1989	26-7-1989
Nitrogen (kg N/ha)						
0	1.14d	1.15d	1.19e	1.21e	1.39e	1.22f
30	1.43c	1.33c	1.53cd	1.40d	1.67d	1.41e
50	1.65b	1.66b	1.65bc	1.73b	1.89b	1.76cd
90	1.59b	1.91a	1.86b	2.00a	1.87bc	2.03a
SE ±	0.040		0.050		0.040	

Interaction means within a week followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 10a Effect of transplanting date, plant population and nitrogen on the leaf dry weight of garden egg (g) during 1989 wet season at Samaru.

Treatments	Weeks after transplanting			
	6	8	10	12
Transplanting date				
5-7-1989	8.74	15.51	18.85	14.94
26-7-1989	11.15	24.06	26.26	21.29
SE ±	2.670	2.760	1.290	2.690
Plant Population (plants/ha)				
20,000	11.79a	27.32a	30.98a	24.32a
40,000	9.61 b	17.21b	21.45b	16.50b
60,000	8.14b	14.83b	15.24c	13.52b
SE ±	0.760	1.690	1.840	1.350
Nitrogen (kg N/ha)				
0	3.83c	11.17c	11.61d	9.11d
30	9.93b	17.13b	18.75c	14.78c
60	10.70b	20.07b	26.79b	20.18b
90	16.16a	30.77a	33.06a	28.40a
SE ±	0.890	1.950	2.120	1.560
Interactions				
DxP	*	NS	NS	*
DxN	NS	NS	NS	NS
PxN	NS	NS	NS	*
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike latter(s) are significantly different at 5% level of significance using DMRT.

same date was compared at different population, it was found that on 26 July 1989, increasing plant population significantly increased leaf dry weight, although there was no difference between 20 and 40,000 plants/ha at 12 WAT. There was no difference between the plant population when crops are transplanted on 5th July 1989 at 6 WAT. However at 12WAT 20,000 plants/ha produced heavier dry leaves than higher levels on 5th July 1989, but the difference between 40 and 60,000 plants/has was not significant statistically.

Interaction between plant population and nitrogen also significantly affected leaf dry weight at 12 WAT (Table 10c) At similar nitrogen levels, 20,000 plants/ha produced the heaviest dry leaves on application of 60 and 90 kg N/ha. The difference between the three plant populations was not significant at 0 kg N/ha. Similarly, the difference between 20 and 40,000 plants/ha was not significant at 30 kg N/ha and that between 40 and 60,000 plants/ha at 60 and 90 kg N/ha.

4.2.9 Stem dry weight

The effect of transplanting date, plant population and nitrogen on the stem dry weight of garden egg is presented on Table 11.

Transplanting on different dates had no significant effect on stem dry weight of garden egg in all the weeks studied.

Table 10b Interaction between transplanting date and plant population as it influenced leaf dry weight of garden egg during 1989 wet season at Samaru.

	Weeks After Transplanting			
Treatment	6		12	
Transplanting date				
	5-7-1989	26-7-1989	5-7-1989	26-7-1989
Plant population (plants/ha)				
20,000	9.20bc	14.37a	23.69a	24.95a
40,000	8.12bc	11.09b	10.48c	22.54a
60,000	8.90bc	7.99c	10.66c	16.39b
SE ±	1.080		1.910	1.910

Interaction means within a week followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Similarly, there was no significant effect on stem dry weight as a result of transplanting at different plant population at 6 WAT. Increasing plant population at 8 and 12 WAT significantly decreased stem dry weight, although the difference between 40 and 60,000 plants/ha was not significant. Stem dry weight decreased significantly with additional increase of 20,000 plants/ha at 10 WAT.

Table 10c Plant population x nitrogen interaction as it influenced the leaf dry weight (g) of garden egg during 1989 wet season at Samaru.

Treatment	Plant population (plants/ha)		
	20,000	40,000	60,000
Nitrogen (kg N/ha)			
0	9.81fg	10.14fg	7.38g
30	18.47cde	16.79de	9.88fg
60	28.73b	17.94cde	13.89ef
90	40.27a	21.13cd	23.78bc
SE ± 2.200			

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Stem dry weight was significantly increased by the application of 30 kg N/ha over the control in all the weeks studied. The difference between 30 and 60 kg N/ha was however, not significant at 6, 8 and 10 WAT. Application of 90 kg N/ha produced significantly heaviest dry stems in all the weeks tested. The difference between the various nitrogen levels was significant at 12 WAT.

There was no significant interaction between the factors in all the weeks tested.

4.2.10 Total dry weight

Table 12a shows the effect of transplanting date, plant population and nitrogen on the total dry weight of garden egg recorded at biweekly intervals.

Transplanting on 26th July 1989 significantly increased total dry weight at 10 WAT. The difference between the two dates was however, not significant in the other weeks.

Similarly, there was no difference in total dry weight due to different planting densities at 6 WAT. Planting at 20,000 plants/ha however, significantly increased total dry weight over 40 and 60,000 plants/ha at 8, 10 and 12 WAT. 40,000 plants/ha similarly, produced heavier total dry weight over 60,000 plants/ha at 10 and 12 WAT, eventhough the difference between the two levels was not significant at 8 WAT.

Table 11 Effect of transplanting date, plant population and nitrogen on stem dry weight (g) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting			
	6	8	10	12
Transplanting date				
5-7-1989	7.00	14.96	21.60	29.21
26-7-1989	4.89	17.88	24.55	26.66
SE ±	1.550	2.610	1.540	0.300
Plant population (plants/ha)				
20,000	6.33	20.66a	30.50a	36.36a
40,000	5.86	15.01b	22.14b	27.48b
60,000	5.63	13.60b	16.58c	23.00b
SE ±	0.610	1.640	1.940	1.730
Nitrogen (kg N/ha)				
0	1.56c	7.26c	8.83c	10.70d
30	4.74b	14.52b	22.51b	27.56c
60	6.72b	17.52b	25.82b	34.27b
90	10.74a	26.39a	35.14a	43.22a
SE ±	0.700	1.890	2.240	2.00
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	NS	NS	NS
PxN	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Heaviest total dry weight were produced on application of 90 kg N/ha and it was significant over all other levels in all the weeks studied. There was no difference in total dry weight between 30 and 60 kg N/ha at 6, 8 and 10 WAT, however, at 12 WAT, application of 60 kg N/ha produced heavier total dry weights over 30 kg N/ha. Similarly, the two levels produced significantly heavier total dry weights over the control.

Significant interaction between transplanting date and plant population influenced total dry weight of garden egg at 6 WAT (Table 12b). When the same populations were compared at different dates, it was found that, transplanting on 5th July 1989 produced heavier total dry weight than the later date at 60,000. The difference between the two dates was not significant at 20 and 40,000 plants/ha. The difference between population densities was not significant on each date.

A significant interaction was also recorded between plant population and nitrogen on total dry weight of garden egg at 12 WAT (Table 12c). When varying nitrogen levels were compared at the same population density, it was observed that application of 90 kg N/ha produced significantly heavier total dry weight at 60,000 plants/ha only. The difference between 90 and 60 kg N/ha was not significant at 20 and 40,000 plants, but the two levels produced significantly heavier total dry weight than 30 kg N/ha at 20,000 plants/ha.

Table 12a Effect of transplanting date, plant population and nitrogen on the total dry weight (g) produced by garden egg plant during 1989 wet season at Samaru.

Treatment	Weeks after transplanting			
	6	8	10	12
Transplanting date				
5-7-1989	16.27	37.12	51.23b	63.83
26-7-1989	16.06	47.10	80.18a	56.08
SE ±	4.210	8.110	4.250	2.67
Plant population (plants/ha)				
20,000	18.21	55.22a	90.54a	75.37a
40,000	15.90	37.42b	62.61b	56.93b
60,000	14.38	33.69b	43.94c	47.56c
SE ±	1.280	4.060	5.000	3.060
Nitrogen (kg N/ha)				
0	5.44c	22.30c	31.47c	29.43d
30	14.01b	35.78b	59.83b	51.08c
60	18.00b	44.20b	74.65b	69.03b
90	27.20a	66.15a	86.88a	89.66a
SE ±	1.480	4.690	5.770	3.540
Interactions				
DxP	*	NS	NS	NS
DxN	NS	NS	NS	NS
PxN	NS	NS	NS	*
DxPxN	NS	NS	NS	*

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

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Table 12 b Interaction between transplanting date and plant population as it affects the total dry weight (g) produced by garden egg at 6 WAT during 1989 wet season at Samaru.

Treatment	Transplanting Date	
	5-7-1989	20-7-89
Plant population (plants/ha)		
20,000	16.20ab	20.21a
40,000	15.52ab	16.27ab
60,000	17.07a	11.70b
SE ± 1.810		

Interaction means followed by unlike letter(s) are significantly different at 5% level of significante using DMRT.

Table 12c Interaction between plant population and nitrogen as it affectstotal dry weight (g) produced by garden egg at 12 WAT during 1989 wet season at Samaru/

Treatment	Plant Population (plants/ha)		
	20,000	40,000	60,000
Nitrogen (kg N/ha)			
0	35.01fg	30.59g	22.68g
30	62.83de	60.40de	31.81g
60	94.15ab	62.16de	50.79ef
90	109.48a	74.56cd	84.94bc
SE ± 6.130			

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Total dry weight was also significantly affected by a second order interaction involving the three treatments at 12 WAT (Table 12d). Heaviest total dry weights were produced at a plant population of 20,000 plants/ha when 60 kg N/ha of nitrogen was applied at a transplanting date of 5th July 1989. However, at the later transplanting date, heaviest total dry weight was produced at a plant population of 20,000 plants/ha when 90 kg N/ha of nitrogen was applied.

4.3 Effect of Transplanting Date, Plant Population and Nitrogen on Fruit Yield of Garden Egg

4.3.1 Fruit fresh weight

The effect of transplanting date, plant population and nitrogen on fruit fresh weight of garden egg is shown on Table 13a.

Fruit fresh weight was not significantly affected by transplanting on different dates at 7, 9 and 13 WAT. However, significantly heavier fresh fruits were produced at 11 WAT by transplanting on 26th July 1989.

Fruit fresh weight was significantly decreased by each additional 20,000 plants/ha at 11 and 13WAT. However, there was no difference between the population densities at 7 and 9 WAT.

Application of nitrogen significantly increased fruit fresh weight over the control in all the weeks tested, and fresh fruit weight significantly increase with each additional

Table 12d Transplanting date x plant population x nitrogen interaction as it influenced total dry weight (g) produced by garden egg at 12 WAT during 1989 wet season at Samaru.

Treatment						
Transplanting date	5-7-1989	5-7-1989	5-7-1989	26-7-1989	26-7-1989	26-7-1989
Plant population (plants/ha)	20,000	40,000	60,000	20,000	40,000	60,000
Nitrogen (kg N/ha)						
0	39.01d-h	31.17e-h	22.00 h	30.90e-h	30.01e-h	22.49gh
30	69.19bc	69.68bc	28.17fgh	50.48b-f	51.12c-h	35.15d-h
60	111.47a	57.98b-e	50.04c-h	70.83bc	66.33bcd	51.34c-g
90	111.04a	87.58bcd	107.65a	107.91a	81.54b	52.26bcd

SE ± 8.070

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

nitrogen up to 90 kg N/ha at 11 WAT. There was no difference between 60 and 90 kg N/ha at 9 and 13 WAT, but the two levels produced heavier fresh fruits than 30 kg N/ha. The difference between the nitrogen levels was not significant at 7 WAT.

A significant interaction was observed between transplanting date and nitrogen at 9 and 11 WAT (Table 13b). When the different transplanting dates were compared at the same nitrogen level, it was found that heaviest fresh fruits were produced at the later date at 11 WAT. However, at 9 WAT, earlier transplanting produced the heaviest fresh fruits only on application of 90 kg N/ha, whereas the difference between the two dates was not significant at other levels. When varying nitrogen levels were compared at the same date, it was observed that, the difference between the nitrogen levels was significant when transplanting is done on 5th July 1989 at 9 WAT, and on 26th July 1989 at 11 WAT.

4.3.2 Fruit dry weight per plant

Table 14a shows the effect of transplanting date, plant population and nitrogen on fruit dry weight per plant of garden egg recorded at biweekly intervals.

Transplanting date did not significantly influence the dry weight of fruits per plant in all the weeks studied.

Fruit dry weight per plant significantly decrease with rising population up to 60,000 plants/ha at 11 and 13 WAT.

Table 13a Effect of transplanting date, plant population and nitrogen on fruit fresh weight (t) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting			
	7	9	11	13
Transplanting date				
5-7-1989	171.94	488.96	274.27b	290.11
20-7-1989	150.60	396.66	459.94a	267.00
SE ±	56.480	52.44	24.130	31.73
Plant population (plants/ha)				
20,000	135.83	196.59	448.88a	349.41a
40,000	176.86	420.51	350.42b	278.92b
60,000	171.12	411.34	302.10c	207.34c
SE ±	15.528	27.730	13.980	18.850
Nitrogen (kg N/ha)				
0	95.54b	205.87c	200.29d	157.71c
30	103.97a	330.54b	320.71c	272.68b
60	193.60a	542.39a	480.50b	313.54a
90	171.82a	620.65a	508.92a	370.29a
SE ±	17.92	32.310	16.190	21.770
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	*	*	NS
PxN	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 13b Transplanting date x nitrogen interaction as it influenced fruit fresh weight (g) of garden egg during 1989 wet season at Samaru

	Weeks after Transplanting			
Treatment	9		11	
Transplanting date				
	5-7-1989	26-7-1989	5-7-1989	-26-7-1989
Nitrogen (kg N/ha)				
0	211.67d	199.67d	172.02f	244.56e
30	397.79c	395.30c	220.03ef	421.39c
60	543.09b	541.68b	329.66d	531.34b
90	803.29a	802.01bc	375.36cd	642.48a
SE ±	45.280		22.640	

Interaction means within a week followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

20,000 plants/ha also produced heavier dry fruits than 60,000 plants/ha at 9 WAT, however, the difference between 20 and 40,000 plants/ha was not significant. Similarly, there was no difference between 40 and 60,000 plants/ha . There was no difference between the various plant populations at 7 WAT.

Application of nitrogen significantly increased fruit dry weight over the control in all the weeks tested. Dry weight of fruits significantly increase with rising nitrogen up to 90 kg N/ha at 11 and 13 WAT. However, there was no difference between 60 and 90 kg N/ha at 9 WAT. Similarly, there was no difference between the nitrogen levels at 7 WAT.

A significant interaction was recorded between transplanting date and nitrogen at 9 WAT (Table 14b). When varying nitrogen levels were compared at the same date, it was observed that on 5th July 1989, fruit dry weight significantly increased with nitrogen addition up to 90 kg N/ha.

4.3.3 Fruit dry weight per plot

Table 15a shows the effect of transplanting date, plant population and nitrogen on the fruit dry weight per plot (7.5m²) of garden egg.

Fruit dry weight per plot was not significantly affected by transplanting on different dates in all the weeks studied.

Table 14 a Effect of transplanting date, plant population and nitrogen on fruit dry weight (g) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting 7	9	11	13
Transplanting date				
5-7-1989	10.30	29.34	24.74	17.39
26-7-1989	10.42	23.75	27.60	15.32
SE ±	3.630	3.140	2.310	0.370
Plant population (plants/ha)				
20,000	8.65	29.79a	31.87a	20.95a
40,000	11.47	25.19ab	25.37b	15.50b
60,000	10.96	24.65b	21.27c	12.61c
SE ±	1.030	1.660	1.160	0.830
Nitrogen (kg N/ha)				
0	6.20b	12.34c	15.06d	9.41d
30	11.69a	23.75b	22.39c	14.96c
60	12.56a	32.54a	31.06b	18.81b
90	10.80a	37.55a	26.16a	22.23a
SE ±q	1.190	1.920	1.340	0.960
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	*	NS	NS
PxN	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 14b Transplanting date x nitrogen interaction as it influenced fruit dry weight (g) of garden egg at 9 WAT during 1989 wet season at Samaru.

Treatment	Transplanting Date	
	5-7-1989	26-7-1989
Nitrogen (kg N/ha)		
0	12.70d	11.98d
30	23.87c	23.62c
60	32.58b	32.50b
90	48.20a	26.91bc
SE ± 2.720		

Interaction means followed by unlike latter(s) are significantly different at 5% level of significance using DMRT.

Increasing plant population significantly increased fruit dry weight per plot in all the weeks tested. Heaviest dry fruits per plot were produced at a plant population of 60,000 plants/ha followed by 40,000 and lastly 20,000 plants/ha.

Nitrogen application significantly increased fruit dry weight per plot over the control in all the weeks tested. Fruit dry weight significantly increased with rising nitrogen up to 90 kg N/ha at 11 and 13 WAT. However, there was no difference between 60 and 90 kg N/ha at 9 WAT, but the two levels produced significantly heavier dry fruits per plot than 30 kg N/ha. Similarly, there was no difference between the three nitrogen levels at 7 WAT.

A significant interaction between transplanting date and nitrogen was observed at 9 WAT (Table 15b). When the various nitrogen levels were compared at the same date, fruit dry weight significantly increased with rising nitrogen on 5th July 1989. Heaviest dry fruits/plot were produced on application of 90 kg N/ha on 5th July 1989, however, on 26th July 1989, heaviest dry fruits/plot were produced on application of 60 kg N/ha.

A significant interaction between plant population and nitrogen also affected fruit dry weight/plot at 9&11 WAT (Table 15c). Heaviest dry fruit/plot were produced by the application of 90 kg N/ha at a plant population of 60,000 plants/ha in both weeks. However, the difference between 60 and 90 kg N/ha was not significant at 60,000 plants/ha and 9 WAT. Similarly, there was no difference between the three nitrogen levels at 20 and 40,000 plants/ha at 9 WAT.

Table 15a Effect of transplanting date, plant population and nitrogen on fruit dry weight (g) per plot (7.5m²) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting 7	9	11	13
Transpolanting date				
5-7-1989	258.66	674.97	553.08	380.58
26-7-1989	257.16	558.71	615.39	334.58
SE ±	91.360	58.570	26.300	7.740
Plant population (plants/ha)				
20,000	103,82c	357.54c	376.22c	251.42c
40,000	275.20b	604.44b	606.98b	367.77b
60,000	394.71a	888.54a	705.51a	453.42a
SE ±	28.190	43.110	26.290	17.440
Nitrogen (kg N/ha)				
0	141.65b	274.23c	333.68d	205.73d
30	292.43a	545.64b	486.69c	322.09c
60	312.73a	772.34a	696.61b	407.19b
90	284.82a	875.14a	813.97a	495.14a
SE ±	32.550	49.780	30.360	20.140
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	*	NS	NS
PxN	NS	*	*	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 15b Interaction between transplanting date and nitrogen as it influenced fruit dry weight (g) per plot (7.5m²) during 1989 wet season at Samaru

Treatment	Transplanting Date	
	5-7-1989	26-7-1989
Nitrogen (kg N/ha)		
0	273.07d	275.40d
30	554.54c	536.75c
60	775.36b	769.33b
90	1096.92a	853.35bc
SE ±	70.400	

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

4.3.4 Total Fruit Yield per hectare at the end of harvest

The effect of transplanting date, plant population and nitrogen on total fruit yield/ha at the end of harvest is presented on Table 16a. Transplanting date had no effect on total yield.

60,000 plants/ha produced the highest total yield over the other plant populations. Total yield was also significantly higher at 40,000 plants/ha than at 20,000 plants/ha.

Table 15c Interaction between plant population and nitrogen as it affects fruit dry weight (g) per plot (7.5m²) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting: 9			11		
Plant population (plants/ha)						
	20,000	40,000	60,000	20,000	40,000	60,000
Nitrogen (kg N/ha)						
0	174.98f	320.24ef	327.48ef	232.94e	319.48de	448.01cd
30	317.44ef	583.29bcd	736.20bc	314.08de	558.16c	587.22c
60	424.19de	698.30bc	1194.48a	441.56cd	753.16b	885.12b
90	513.54cde	815.38b	1295.99a	523.71c	795.12b	1141.93a
SE ±	80.220			52.590		

Interaction means within each week followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Nitrogen application significantly increased total yield over the control with application of 90 kg N/ha resulting in the highest yield. Application of 60 kg N/ha similarly increased total yield over 30 kg N/ha.

A significant interaction between transplanting date and nitrogen was found to influence total yield/ha (Table 16b). Comparing same nitrogen levels at different dates, it was found that on application of 90 kg N/ha, higher total yield was obtained on transplanting early. The difference between the two dates was not significant when nitrogen less than 90 kg N/ha was applied. When varying nitrogen levels were compared at the same date, it was observed that, total yield significantly increased with each additional 30 kg N/ha upto 90 kg N/ha on 5th July 1989. At the latter date, there was no difference between 60 and 90 kg N/ha but the two levels produced significantly higher total yield than 30 kg N/ha.

Plant population x nitrogen interaction similarly affected total yield/ha (Table 16c). At the same nitrogen level, higher total yield was produced at the plant population of 60,000 plants/ha. The density of 40,000 also produced significantly higher total yield/ha than 20,000 plants/ha.

4.4 Effect of Transplanting Date, Plant Population and Nitrogen on Yield Components of Garden Egg

4.4.1 Number of fruits per plant

Data on the effect of transplanting date, plant population and nitrogen on number of fruits of garden egg plant are presented on Table 17a.

Table 16a Effect of transplanting date, plant population and nitrogen on total fruit yield/ha (tons) at the end of harvest (13 WAT) during 1989 wet season at Samaru.

Treatment	Yield/ha (tons)
Transplanting date	
5-7-1989	8.53
10-7-1989	8.09
SE ±	0.690
Plant population (plants/ha)	
20,000	2.19c
40,000	7.62b
60,000	15.01a
SE ±	0.340
Nitrogen (kg N/ha)	
0	4.19d
30	7.37c
60	9.98b
90	11.59a
SE ±	0.390
Interactions	
DxP	NS
DxN	*
PxN	*
DxPxN	NS

Means in a column of any set of treatment followed by unlike letters are significantly different at 5% level of significance using DMRT.

Table 16b Interaction between transplanting date and nitrogen as it affects total fruit yield (tons) per hectare at the end of harvest (13 WAT) during 1989 wet season at Samaru.

Treatment	Transplanting Date	
	5-7-1989	26-7-1989
Nitrogen (kg N/ha)		
0	4.13d	4.25d
30	6.98c	7.76c
60	10.26b	9.69b
90	12.73a	10.38b
SE ± 0.560		

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 16c Interaction between plant population and nitrogen as it influenced total fruit yield (tons)/ha at the end of harvest (13 WAT) during 1989 wet season at Samaru.

Treatment	Plant Population		
	20,000	40,000	60,000
Nitrogen (kg N/ha)			
0	1.25g	4.26f	7.06e
30	2.02g	7.19e	12.88c
60	2.57fg	8.83de	18.56b
90	2.92fg	10.20cd	21.55a
SE ± 0.600			

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Number of fruits per plant was not significantly affected by transplanting on different dates at 7, 9 and 13 WAT. However, more fruits were produced at 11 WAT when plants were transplanted on 26th July 1989 than 25th July 1989. Increasing plant population from 20 to 40,000 plants/ha significantly increased fruit number at 7 WAT only, while fruit number was decreased in the remaining weeks. However, fruit number was not significantly influenced by a further increase to 60,000 plants in all the weeks tested. Similarly, there was no difference between 20 and 60,000 plants/ha at 7 WAT.

Number of fruits per plant was significantly increased by the application of nitrogen over the control in all the weeks tested. However, there was no difference between the three nitrogen levels at 7 WAT. The difference between 60 and 90 kg N/ha was similarly, not significant at 9 WAT, but the two levels produced significantly more fruits than 30 kg N/ha. Conversely, at 13 WAT the difference between 30 and 60 kg N/ha was not significant statistically but the two levels produced significantly less fruits than 90 kg N/ha. Significantly more fruits were produced with each additional 30 kg N/ha up to 90 kg N/ha at 11 WAT.

A significant interaction between transplanting date and nitrogen was recorded at 9 and 11 WAT (Table 17b) When the same nitrogen level was compared at different dates, it was found that more fruits were produced when plants

Table 17a Effect of transplanting date, plant population and nitrogen on the number of fruits produced by garden egg plant during 1989 wet season at Samaru.

Treatment	Weeks after transplanting 7	9	11	13
Transplanting date				
5-7-1989	3.79	7.66	3.76b	4.60
26-7-1989	2.14	4.84	6.15a	3.86
SE ±	0.760	0.540	0.140	0.358
Plant population (plants/ha)				
20,000	2.46b	7.21a	6.05a	4.83a
40,000	3.39a	6.03b	4.51b	4.13b
60,000	2.99ab	5.51b	4.30b	3.72b
SE ±	0.240	0.330	0.220	0.190
Nitrogen (kg N/ha)				
0	2.07b	3.35c	2.91d	2.78a
30	3.19a	5.89b	4.52c	4.00b
60	3.37a	7.83a	5.50b	4.19b
90	3.15a	7.93a	6.89a	5.84a
SE ±	0.280	0.380	0.250	0.220
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	*	*	NS
PxN	NS	NS	NS	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 17b Transplanting date x nitrogen interaction as it influenced number of fruit produced by pardun egg during 1989 wet season at Samaru.

Treatment	Weeks After Transplanting			
	9		11	
Transplanting date				
	5-7-1989	26-7-1989	5-7-1989	26-7-1989
Nitrogen (kg N/ha)				
0	4.07de	2.63e	2.67f	3.15ef
40	7.07b	4.70cd	3.44ef	5.60c
60	9.26a	5.41b	4.04de	6.96b
90	10.22a	5.63bcd	4.59cd	8.89a
SE ±	0.530		0.350	

Interaction means within each week followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

were transplanted early at 9 WAT, however, at 11 WAT more fruits were produced at the latter date. The difference in number of fruits produced between the two dates was not significant at 0 kg N/ha.

4.4.2 Fruit diameter

Table 18a shows the effect of transplanting date, plant population and nitrogen on the fruit diameter of garden egg.

Transplanting on 5th July 1989 significantly increased fruit diameter at 11 and 13 WAT. However, there was no difference between the two dates at 7 and 9 WAT.

Fruit diameter significantly decrease with increase in plant population at 11 and 13 WAT. However, the difference between 40 and 60,000 plants/ha was not significant at 11 and 13 WAT. Similarly, there was no difference between 20 and 40,000 plants/ha at 11 WAT. Fruit diameter was not affected significantly by changes in plant population at 7 and 9 WAT.

Fruit diameter was significantly increased by the application of nitrogen at 9, 11 and 13 WAT. At 7 WAT, nitrogen application had no significant influence on fruit diameter. There was no difference between 30 and 60 kg N/ha at 9 and 11 WAT but the two levels produced significantly smaller fruits than the application of 90 kg N/ha. At 13 WAT,

Table 18a Effect of transplanting date, plant population and nitrogen on fruit diameter (cm) of garden egg during 1989 wet season at Samaru.

Treatment	Weeks after transplanting 7	9	11	13
Transplanting date				
5-7-1989	5.14	5.50	6.18a	6.03a
26-7-1989	5.79	6.51	5.97b	5.89b
SE ±	0.340	0.210	0.040	0.050
Plant population (plants/ha)				
20,000	5.33	6.09	6.20a	6.08a
40,000	5.51	6.02	6.10ab	5.90b
60,000	5.53	5.91	5.93b	5.90b
SE ±	0.140	0.090	0.060	0.060
Nitrogen (kg N/ha)				
0	5.22	5.61c	5.86c	5.91b
30	5.56	5.96b	5.98b	5.70c
60	5.61	6.02b	6.17b	6.08a
90	5.46	6.43a	6.49a	6.14a
SE ±	0.160	0.100	0.070	0.070
Interactions				
DxP	NS	NS	NS	NS
DxN	NS	NS	NS	NS
PxN	NS	NS	*	NS
DxPxN	NS	NS	NS	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

Table 18b Interaction between plant population and nitrogen as it affects the fruit diameter (cm) of garden egg at 11 WAT during 1989 wet season at Samaru.

	Plant population (plants/ha)		
Treatment	20,000	40,000	60,000
Nitrogen (kg N/ha)			
0	5.86cde	5.57de	5.55e
30	5.90cd	6.30bc	5.84de
60	6.31b	6.32b	6.07cde
90	6.73a	6.29b	6.44ab
SE ± 0.120			

Interaction means followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

the difference between 60 and 90 kg N/ha was not significant, but the two levels produced significantly bigger fruits than 30 kg and 0 kg N/ha. 30 kg N/ha was also significantly lower than 0 kg N/ha.

A significant interaction was observed between plant population and nitrogen at 11 WAT (Table 18b). Biggest fruits were produced on application of 90 kg N/ha at a plant population of 20,000 plants/ha, while the smaller fruits were produced at the control in combination with 60,000 plants/ha.

4.4.3 Number of days to fifty percent flowering

Data on the effect of transplanting date, plant population and nitrogen on the number of days to 50% flowering is shown on Table 19.

Transplanting date did not significantly influence the number of days to 50% flowering in garden egg. Similarly, number of days to 50% flowering was not affected by differences in plant population.

Nitrogen application significantly reduced the number of days to 50% flowering over the control. 90 kg N/ha gave the earliest days to 50% flowering, followed by 60 kg N/ha which is significantly lower than 30 kg N/ha.

There was no significant interaction between any of the factors on number of days to 50% flowering.

4.4.4 Crude protein content

Table 20 shows the effect of transplanting date, plant population and nitrogen on the crude protein content of fruits of garden egg.

Crude protein content of fruits was not significantly influenced by transplanting on different dates. Similarly, increase in plant population had no significant effect on crude protein content of fruits.

Application of 60 kg N/ha significantly increased the crude protein content of fruits over 30 kg N/ha and the control. Addition of 30 kg N/ha more did not significantly increase

Table 19 Effect of transplanting date, plant population and nitrogen number on number of days to fifty percent flowering in garden egg during 1989 wet season at Samaru.

Treatment	Number of days to 50% flowering
Transplanting date	
5-7-1989	30.56
26-7-1989	35.69
SE ±	2.240
Plant population (plants/ha)	
20,000	32.42
40,000	33.83
60,000	33.56
SE ±	0.800
Nitrogen (kg N/ha)	
0	37.22d
30	34.50c
60	32.11b
90	29.28a
SE ±	0.800
Interactions	
DxP	NS
DxN	NS
PxN	NS
DxPxN	NS

Means in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DNRT.

Table 20 Effect of transplanting date, plant population and nitrogen on crude protein content of fruits (%) of garden egg taken at 8 WAT during 1989 wet season at Samaru.

Treatment	Crude protein content of fruits(%)
Transplanting date	
5-7-1989	22.17
26-7-1989	21.31
SE ±	1.810
Plant population (plants/ha)	
20,000	21.92
40,000	21.57
60,000	21.72
SE ±	0.030
Nitrogen (kg N/ha)	
0	20.39b
30	20.21b
60	22.02a
90	23.42a
SE ±	0.350
Interactions	
DxP	NS
DxN	NS
PxN	NS
DxPxN	NS

Mean in a column of any set of treatment followed by unlike letter(s) are significantly different at 5% level of significance using DMRT.

the crude protein content of fruit. There was no difference between 0 and 30 kg N/ha. The difference between 60 and 90 kg N/ha was also not significant statistically.

4.5 Correlation

Table 21 shows the result of correlation study carried out to determine the association between some of the parameters assessed.

The result of the analyses shows that there was a positive and highly significant correlation between fruit yield and fruit dry weight, number of fruits, plant height, number of leaves per plant, number of branches, plant leaf spread, leaf dry weight and stem dry weight. The correlation between fruit yield and leaf area index was positive and significant while that between fruit yield and number of days to fifty percent flowering was negative and highly significant.

There was also a positive and highly significant correlation between the following parameters; fruit dry weight number of fruits, plant height, number of leaves per plant, number of branches, plant leaf spread, leaf dry weight and stem dry weight. However, the correlation between leaf dry weight and number of leaves and branches per plant was positive but significant.

The correlation between leaf area index and other parameters was not significant except with plant leaf spread and stem dry weight which was positive and significant.

There was a negative and highly significant correlation between number of days to fifty percent flowering and fruit dry weight, number of fruits, plant height, and stem dry weight, while it was negative but significant with number of leaves and plant leaf spread. Correlation between number of days to fifty percent flowering and number of branches and leaf area index was not significant.

Table 21 Simple correlation coeffcieint between fruit yield (FY), fruit dry weight (FDW), number of fruits (NF plant height (PH), number of leaves per plant (NL), Number of branches (NB), Leaf area index (LAI), plant leaf spread (PL), leaf dry weight (LDW), stem dry weight (SDW) and number of days to 50% flowering (NDF)

	FY	FDW	NF	PH	NL	NB	LAI	PL	LDW	SDW	NDF
FY	1.00										
FDW	0.982**	1.00									
NF	0.892**	0.921**	1.00								
PH	0.701**	0.729**	0.768**	1.00							
NL	0.692**	0.719**	0.748**	0.702**	1.00						
NB	0.696**	0.671**	0.688**	0.621**	0.774**	1.00					
LAI	0.415*	0.399	0.359	0.378	0.298	0.319	1.00				
PL	0.619**	0.624**	0.578**	0.517**	0.552**	0.552**	0.440*	1.00			
LDW	0.694**	0.649**	0.582**	0.389	0.446**	0.527**	0.373	0.571**	1.00		
SDW	0.743**	0.723**	0.679**	0.529**	0.511*	0.503*	0.404*	0.582**	0.915**	1.00	
NDF	-0.544**	-0.600**	-0.689**	-0.542**	-0.469*	-0.364	-0.141	-0.450*	-0.392	-0.549**	1.00

Values equal to or greater than (0.404)* are significant at 5% significant level
Values equal to or greate than (0.515)** are significant at 1% significant level

Chapter 5

DISCUSSION

5.1 Effect of Transplanting Date on the Growth of Garden Egg

The results from this study indicates that, transplanting date did not significantly affect most of the growth parameters of garden egg in all the weeks studied. This might be due to the fact that, garden egg is the most thermophyllic of the solanaceous crops (Boswell and Jones, 1941) is adopted to both dry and wet season cultivation (Tindall, 1968) and can be grown successfully under a continuous long warm weather during growth and fruit maturation (Yamaguchi, 1983) which was obtained throughout the period of this study (Table 2).

Plant height, number of branches per plant, number of leaves per m^2, plant leaf spread, stem diameter, leaf dry weight, stem dry weight, were not significantly influenced by transplanting date in all the weeks studied. These results are in agreement with the findings of Nothmann et al. (1979) who also did not find any difference in garden egg growth in cultivars grown during the hot-season (May-November). However, it contradicts the findings of Rylski et al (1976) and Eguchi (1962) who reported significant difference in garden egg growth and development. This contradiction can be explained by the fact that in their own study, Rylski (1976) and

Eguchi (1962) observed a sharp difference in soil temperatures and daily mean temperature between the transplanting dates respectively; whereas no such marked difference in temperature between the transplanting dates was observed in this investigation.

However, significantly more leaves per plant were produced at 5 and 11 weeks after transplanting in plants transplanted on 5th July 1989 than in those transplanted on 26th July 1989. This can be attributed to higher sunshine hours available to the plants transplanted on 5th July 1989 at the initial stage of the experiment which consequently stimulate and accelerate leaf production. Sunshine hours has been reported to accelerate leaf production in plants (Krizek et al., 1966).

Conversely, significantly higher leaf area index was obtained at 10 weeks after transplanting in plants transplanted on 26 July 1989 when compared with plants transplanted on 5th July 1989. This difference can also be related to light intensity and duration both of which affect th size and longavity of the leaf (Mitchell, 1976). The difference in leaf area index between the two transplanting dates can also be viewed from the way assimilates are partitioned among the various plant parts. As plants transplanted on 5th July 1989 produced significantly more leaves than those transplanted on 26th July 1989, more assimilate will be available to each individual leaf to permit greater expansion in plants

transplantad on 26th July 1989 than those transplanted on 5th July 1989. Khan (1981), Khan and Asif (1981) and Jay (1983) have shown that although an individual leaf exports only a limited portion of its photosynthate, the portion that is exported will be shared equitably by the rest of the plant. Similarly, total dry weight produced per plant was higher at 10 WAT in plants transplanted on 26th July 1989 than in plants transplanted on 5th July 1989. This is probably due to the higher leaf area index of plants grown on 26th July 1989 thus enabling them to have a higher photosynthetic capacity than plants transplanted on 5th July 1989 which have a significantly lower leaf area index. This tallies with the finding of Brougham (1956) who found that both percentage of solar radiation interception and rate of dry matter production increases with leaf area development.

5. .2 Effect of Transplanting Date on the Yield and Yield Components of Garden Egg

Transplanting on 26th July 1989 significantly increased fruit yield and number of fruits produced per plant at 11 weeks after transplanting over 5th July 1989 transplanting. This is due to the higher leaf area index of plants transplanted on 26th July 1989 which afforded them greater photosynthetic area, and ensuring greater light interception and carbon dioxide assimilation. This agrees with findings of Brammer and Wadley (1966) who found yield to be closely correlated with leaf area index.

However, fruit diameter was higher in plants transplanted on 5th July 1989 than in plants transplanted on 26th July 1989 at 11 and 13 weeks after transplanting. This corroborates the findings of Nwosah (1970), Abdel-al (1973) and Hammouda et al. (1982). This might be due to the increased number of leaves per plant at 11 weeks after transplanting in plants transplanted on 5th July 1989 and the abundant sunshine available at that period.

However, fruit dry weight per plant, fruit dry weight per plot and total fruit yield at the end of harvest per hectare were not significantly influenced by transplanting date. This contradicts the findings of Abdel-Al (1973) and Verma (1980) who reported higher yields with early transplanting. This difference is due to the fact that there was no marked difference in weather conditions between the transplanting dates in this investigation as was obtained by the previous authors in their own experiment.

Similarly, transplanting date did not signficantly affect number of days to fifty percent flowering and crude protein content of fruits. The non significant difference in these variables can also be related to the continuous long warm weather obtained throughout this investigations, which has been reported to favours successful garden egg production (Yamaguchi, 1983). The result also seems to confirms the views of Westermann and Crothers (1977) who found that yield

components changes emanate from the plants response to its environment which may or may not permit the full genetic expression of each component.

5.3 Effect of Plant Population on the Growth of Garden Egg

Plant height was not significantly influenced by differences in plant population. This can be attributed to the ranked growth in densely populated plants due to greater competition for light which induced etiolation resulting in tall spindly plants. This agrees with the findings of Robinson et al. (1976) and Nger et al. (1978) who found increase in plant height with increase in plant population. This becomes more evident when the stem diameter of the various plant population was compared, wherein stem diameter decreased with increase in plant population. This result seems to agree with the results obtained by Lopez (1972) who reported thicker stems with increase in the spacing between sunflower plants. Thus although plants at low population have the potential ability of growing taller than densely populated plants due to adequate nutrients and light, the difference in height between the two groups was not signficant due to the ranked and etiolated growth of the latter. However, increase in plant population from 40,000 plants/ha to 60,000 plants/ha did not significantly decrease stem diameter further. This might be due to the same degree of competition within the two populations.

Number of branches per plant, number of leaves per plant, plant leaf spread, leaf dry weight, stem dry weight and total dry weight were all significantly decreased with increase in plant population. This might be due to the fact that increase in plant population exerts an adverse effect on the development of buds from which the branches and leaves develop as a result of vigorous competition for light, nutrients and space between the plants. The decrease in number of branches, leaves and plant leaf spread consequently decreased leaf, stem and total dry weights. However, number of branches, number of leaves and plant leaf spread did not -significantly decrease further as the plant population was increased further from 40,000 plants/ha to 60,000 plants/ha. This could be due to the same degree of competition within the two plant population.

Number of leaves per m^2 and leaf area index however, significantly increased with increase in plant population. This is due to the higher number of plants per area which more than compensate the low number of leaves per plant at higher plant population.

5.4 Effect of Plant Population on the Yield and Yield Components of Garden Egg

Fruit fresh weight per plant and fruit dry weight per plant significantly decreased with increase in plant

population. This is in agreement with the findings of Seth and Dhauder (1972) and Asiegbu and Uzo (1984) who observed increase in plant population to decrease productivity per plant. This could be due to the high degree of competition among the plants grown at high population densities. The difference in yield per plant could also be due to higher number of leaves and branches and wider plant leaf spread exhibited by the plants at low population, therefore enhancing the interception of greater amounts of light energy which is used to produce more assimilate.

However, fruit dry weight per plot (7.5m²) and total fruit yield at the end of harvest per hectare were significantly higher at higher plant population when compared with the lower plant population. These results are in conformity with the results obtained by Sulikeri (1977), Hammouda et al (1982) and Asiegbu and Uzo (1984) who found higher yields per hectare at higher plant populations. Regression analysis showed that there is a positive linear response in total yield/ha to plant population (Figure 1).

Number of fruits per plant and fruit diameter similarly decreased with increase in plant population. This can also be traced to the increase in competition between the plants at high plant population. However, there is no difference between 40,000 and 60,000 plants per hectare.

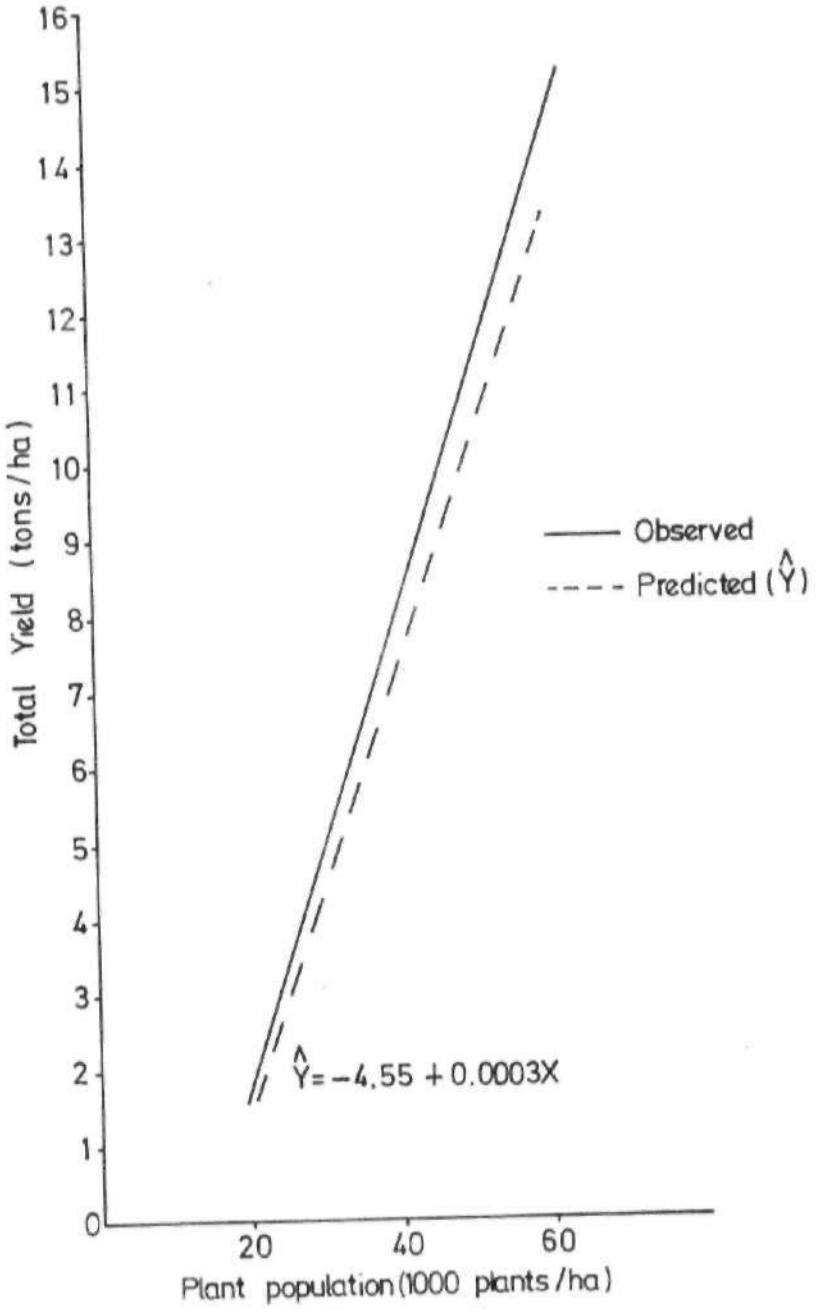


Figure 1. Response of Garden Egg yield to plant plant population

Plant population did not significantly influence number of days to fifty percent flowering and crude protein content of fruits. This could be due to the fact that yield components differences depend on the plant's response to the environment which may or may not permit the full genetic expression of each component (Westermann and Crothers, 1977).

5.5 Effect of Nitrogen on the Growth of Garden Egg

Nitrogen application significantly increased all growth parameters over the control in all the weeks studied. This may not be unconnected with the fact that nitrogen is an essential constituent of garden egg metabolites and chlorophyll necessary for promoting aerial vegetative growth, increasing the top-root ratio and essential for fruit and seed formation (Olson et al., 1971).

Plant leaf spread, stem diameter and leaf dry weight significantly increased with each nitrogen level. Similarly, stem dry weight and total dry weight increased with each additional level at 12 weeks after transplanting. In previous weeks, the difference in stem and total dry weight due to 30 and 60 kg N/ha was not significant. These results are in conformity with the findings of Rajeeven and Rao (1979), Takahashi et al. (1979) who observed that plants receiving nitrogen grew faster than those receiving low nitrogens and those of Singh and Sandu (1970), who observed that nitrogen application up to 100 kg N/ha increased stem diameter.

Similarly, nitrogen application significantly increased plant height, number of leaves per plant, number of leaves per m^2, number of branches per plant and leaf area index. These results corroborates the findings of Singh and Sandhu (1970) and Choudhury et al. (1982). The increase in these parameters due to nitrogen application is due to the ability of nitrogen to stimulate the production of leaves and branches and also promote aerial vegetative growth (Olson et al., 1971) as nitrogen is an important constituent of chlorophyll, amino acid and nucleic acid (Sauchelli, 1978; Bhatnagar and Pandita, 1979). However, plant height, number of leaves per plant, number of leaves per m^2, number of branches per plant were not significantly increased beyond the 60 kg N/ha. These findings are similar to that of Ezeakunne (1985) who opined that the inability of nitrogen to increase number of branches beyond 75 kg N/ha might be due to the limited capacity of the plant to utilize greater amount of nitrogen beyond a certain optimum. Similarly, there was no significant difference in leaf area index due to 30 and 60 kg N/ha, although 90 kg N/ha significantly increased leaf area index over all other levels.

5.6 Effect of nitrogen on the Yield and Yield Components of Garden Egg

Nitrogen application significantly increased fruit fresh weight per plant, fruit dry weight per plant, fruit dry weight per plot and total fruit yield per hectare

at the end of harvest over the control. These parameters also increase with rising nitrogen up to 90 kg N/ha although addition of nitrogen beyond 60 kg N/ha did not significantly increase fruit fresh weight per plant except at 11 weeks after transplanting and fruit dry weight per plant and per plot at 7 and 9 weeks after transplanting. These results are similar to those obtained by Sulikeri (1977), Kalyanasundaran and Sambandam (1979), Kogbe (1982) and Ezeakunne (1985) who reported total yield per hectare to increase with rising nitrogen upto 80, 200, 100 and 150 kg N/ha respectively. In this experiment, total yield per hectare was significantly increased from 4.19 tons in the control to 7.37, 9.98 and 11.55 tons by the application of 30, 60 and 90 kg N/ha respectively. The response of total yield /ha to nitrogen is presented on Figure 2. The response was linear with a mean rate of about 0.082 t kg N/ha. Increase in yield as a result of nitrogen application could be due to the increase in number of leaves, plant leaf spread, and leaf area index thereby resulting in greater photosynthetic capacity and rapid assimilate translocation due to the vigorous vegetative growth thus resulting in the production of a large number of big fruits. Nitrogen has also been reported to stimulate the production of large number of flowers and high fruit set (Takahachi et al. 1979).

Number of fruits per plant, fruit diameter, decreasing number of days to fifty percent flowering and fruit crude protein content were also similarly increased by nitrogen

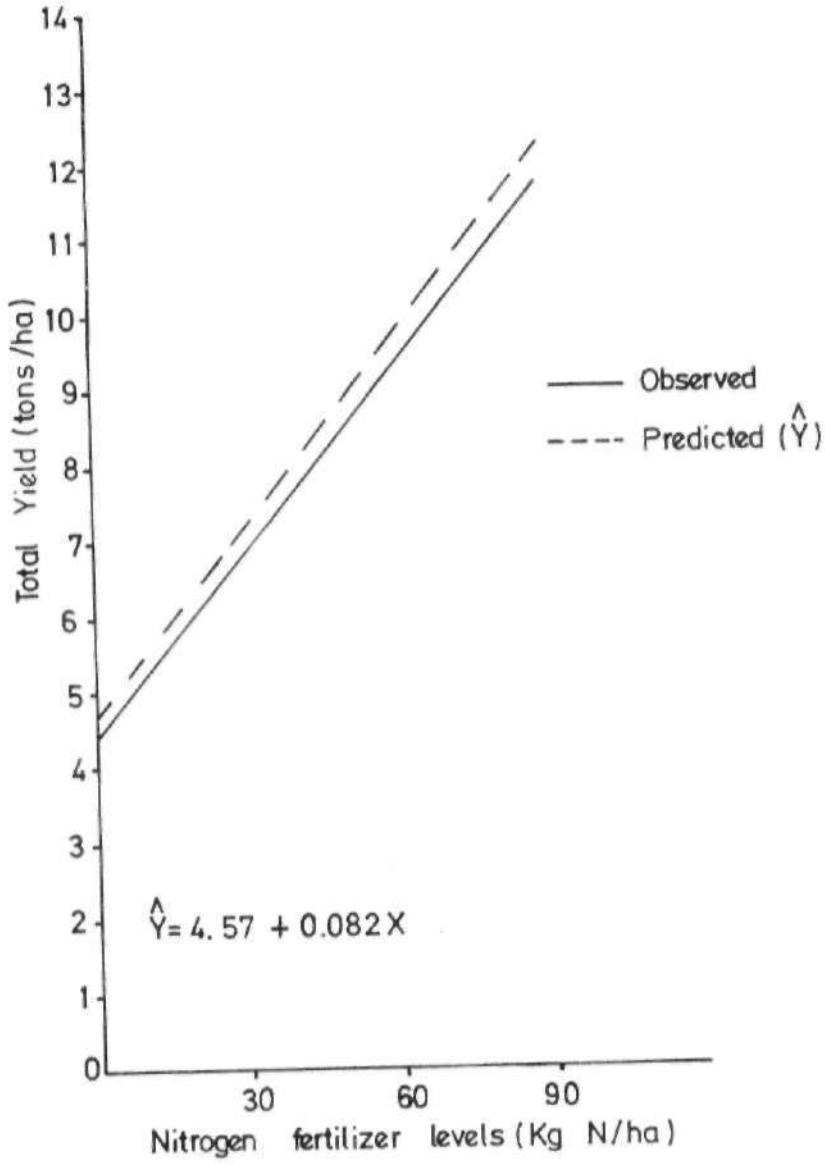


Figure 2. Response of Garden Egg yield to nitrogen application

application. This confirms the findings of Singh and Sandhu (1970), Gupta and Shukla (1977) and Takahachi et al. (1979) who reported increased number of fruits, increased fruit size and early flowering with nitrogen application respectively. This could be attributed to the ability of nitrogen to promote vigorous foliage growth, increased meristematic and physiological activities in the plants thereby resulting in the synthesis of more photo-assimilates which is used in producing more fruits. Crude protein content of fruits was increased by nitrogen addition because nitrogen is a constituent of proteins and its addition, result in more synthesis of protein. Similar result was obtained by Vuurmans and Grubben (1977) . The non-significant difference between 0 and 30 kg N/ha in crude protein content could be due to the leaching of the nitrogen in the soil and its diversion in the plant to other meristematic regions.

5.7 Interactions

A lot of interactions were obtained between the factors on most of the parameters measured. In some cases significant interaction was even obtained between some of the treatments whose effect on the parameter tested was not significant. This is due to the nature of the design used in the experiment. In the split-plot design, factors at the sub-plot level which includes the interactions were evaluated at higher precision than other factors contained

in the main plot (Gomez and Gomez, 1976).

5.7.1 Transplanting date x plant population

Significant interactions was recorded between transplanting date and plant population on number of branches per plant, number of leaves per plant, number of leaves per m^2, leaf dry weight and total dry weight.

Transplanting on 5th July 1989 in combination with 60,000 plants/ha produced the highest number of branches, number of leaves per plant and number of leaves per m^2. Whereas transplanting on 26th July 1989 in combination with 20,000 plants/ha produced the heaviest leaf and total dry weight per plant. These findings resemble the results obtained by Rajput (1968) who reported that interaction between the number of plants and time of transplanting had significant effects on growth and yield. Similar results were obtained by Cardwell (1967) in corn, who observed that a change in one cultural practice gives an interaction resulting in a change of another factor; that is, planting earlier reduced the plant's sensitivity to high population.

5.7.2 Transplanting date x nitrogen

Transplanting date x nitrogen interaction significantly affected number of branches per plant, stem diameter, fruit fresh weight, fruit dry weight per plant, fruit dry weight

per plot, total yield per hectare and number of fruits per plant.

Highest number of plants, heaviest dry fruits per plant and per plot and highest total yield per hectare were produced at a transp. lanting of 5th July 1989 in combination with 90 kg N/ha. Whereas thickest stems were produced at a transplanting of 26th July 1989 in combination with 90 kg N/ha. However, heaviest fresh fruits were produced on application of 90 kg N/ha when plants were transplanted on 5th July 1989 at 9 WAT, while at 11 WAT 90 kg N/ha in combination with . transplanting on 26th July 1989 produced heaviest fresh fruits. The results indicate that nitrogen application can improve the growth and yield of garden egg at either of the two transplanting dates.

5.7.3 Plant population x nitrogen

Growth, yield and yield components parameters such as number of leaves per m^2, leaf area index, leaf and total dry weights, fruit dry weight per plot, total yield per hectare and fruit diameter were significantly influenced by plant population x nitrogen interaction.

At 60,000 plants/ha, there was an increase in number of leaves per m^2, leaf area index, fruit dry weight per plot and total fruit yield per hectare with each increment of 30 kg N/ha upto 90 kg N/ha at which the highest value was

obtained. These results confirms the findings of Gerardo (1981) who reported a gradual response in garden egg yield with each increment of 112 kg N/ha up to 450 kg N/ha in densely populated plants. Similar results were obtained by Lang et al (1956) who reported that as density is increased the response to an added nutrient continued to a higher level of application.

5.7.4 Transplanting date x plant population x nitrogen

Leaf area index and total dry weight were significantly affected by a second order interaction involving all three treatments.

Highest leaf area index was obtained at a plant population of 60,000 plants/ha on application of 93 kg N/ha when plants are transplanted on 5th July 1989. However, heaviest total dry weight was obtained at a plant population of 20,000 plants/ha on application of 90 kg N/ha when transplanted on 5th July 1989. These results indicate that, the difference in climatic factors under which plants are grown requires changes in plant population in order to get the best use of the prevailing climatic factors as observed by Gupta (1984).

5.8 Correlation

A significant and positive correlation was recorded between fruit yield, fruit dry weight, number of fruits per plant, plant height, number of leaves per plant, number

of branches per plant, plant leaf spread, leaf dry weight and stem dry weight. This positive and significant correlation indicates that these are critical determinants of garden egg yield. These results corroborates the findings of Shrivastrava and Sachan (1973), Martia and Chauhan (1978) Addaekagya and Norman (1977) and Singh and Khanna (1978) who found significant correlation between yield and number of fruits per plant, plant height, plant leaf spread, and number of branches per plant, respectively.

Number of days to fifty percent flowering was negatively correlated with all other parameters. This result is similar to that obtained by Vijay et al. (1978) who observed a negative correlation between fruit number and number of days to fifty percent flowering.

Chapter 6

SUMMARY AND CONCLUSIONS

A field experiment was conducted to determine the affect of transplanting date, plant population and nitrogen on the growth, yield and yield components of garden egg variety 'White light'. The experiment was carried out during the rainy season of 1989 at the Horticultural Field Unit of the i Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria. The experiment consisted of twenty four treatments with each treatment containing one of two transplanting dates (5th July 1989 and 26th July 1989), one of three planting population (20,000, 40,000 and 60,000 plants/ha) and one of four nitrogen levels (0, 30, 60 and 90 kg N/ha). The treatments were completely randomized, replicated three times and laid out in a split-plot design with the transplanting date being allocated to the main plot while nitrogen and plant population were allocated to the sub-plot.

Plant height, number of branches per plant, number of leaves per m^2, plant leaf spread, stem diameter, leaf dry weight, stem dry weight, fruit dry weight per plant, fruit dry weight per plot and total fruit yield/hectare were not significantly influenced by transplanting date. Similarly, transplanting date had no significant effect on number of days to fifty percent flowering and crude protein content of fruits.

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however, transplanting on 5th July 1989 significantly increased number of leaves per plant, and fruit diameter, while transplanting on 26th July 1989 significantly increased leaf area index and total dry weight per plant.

Increasing plant population significantly decreased stem diameter, number of branches per plant, number of leaves per plant, plant leaf spread, leaf dry weight, stem dry weight and total dry weight. Similarly, fruit fresh weight, fruit dry weight per plant, number of fruits per plant and fruit diameter were decreased with increase in plant population.

Number of leaves per m^2 and leaf area index were however increased by increase in plant population. Fruit dry weight per plot and total fruit yield per hectare at the end of harvest were similarly increased by planting at high populations.

Plant height, number of days to fifty percent flowering, and crude protein content of fruits were not significantly affected by plant population.

Nitrogen application significantly increased all growth and yield parameters over the control in all the weeks studied. Plant leaf spread, stem diameter, and leaf dry weight significantly increased with each additional 30 kg N/ha up to 90 kg N/ha. Similarly, fruit fresh weight, fruit dry weight per plant, fruit dry weight per plot and total fruit yield at the end of harvest progressively

responded to each additional 30 kg N/ha up to 90 kg N/ha. Total fruit yield per hectare was significantly increased from 4.19 tons in the control to 7.37, 9.98, and 11.55 tons on application of 30, 60 and 90 kg N/ha respectively which is equal to 76,138 and 175 percent increase over the control, respectively.

Number of leaves per plant & per m², plant height, number of branches per plant were not significantly increased beyond 60 kg N/ha.

Significant interactions were obtained between the treatments on number of branches, number of leaves per plant and per m², leaf dry weight, stem dry weight, total dry weight, fruit fresh weight, fruit dry weight per plant and per plot, and number of fruits per plant. Significant interactionswere also recorded on total yield/ha, fruit diameter, and leaf area index.

A significant and positive correlation was obtained between fruit yield and all parameters measured except number of days to fifty percent flowering which was negatively correlated with fruit yield.

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BIOGRAPHY: Lamido Aliyu

NAME:	L. Aliyu
DATE OF BIRTH:	4th February 1965
BUSINESS ADDRESS	Agronomy Department, Ahmadu Bello Univ., Zaria.
HOME ADDRESS:	No. 557 K/Nasarawa, Kano City, Kano State.
PREVIOUS QUALIFICATIONS:	B.Sc (Agriculture)

INSTITUTIONS ATTENDED	PERIOD	CERT./DIPLOMA/DEGREE
Kwalli Primary School	1970-77	School Leaving Certificate
Govt. Sec. School, Gwarzo	1977-82	WASC
SBS, A.B U. Zaria	1982-83	IJMB
Ahmadu Bello University, Zaria	1983-87	B.Sc (Agriculture)

POST(S) HELD SINCE THE AWARD OF FIRST DEGREE

Organisation	Period	Position
NYSC	1987-88	Teacher
Ministry of Education Kano State	Aug-Nov 1988	Education Officer
Ahmadu Bello University, Zaria	1988-date	Asst Lecturer

YEAR OF ADMISSION TO POSTGRADUATE STUDIES: 1988

ADMISSION NUMBER: M.Sc/Agric/494/88-89

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