International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Agronomic Evaluation of Okra under Different Irrigation and Soil Management Practices at Isampou, Bayelsa State, Nigeria

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Abstract: ***Effect of irrigation and soil amendment practices were tested on okra yields at Isampou, Bayelsa State. The experimental design was split-plot fitted into randomized complete blocks. Irrigation regimes 20,000; 25,000 and 30,000 l ha^{-1} day occupied the main plots while soil amendments (poultry manure PM 5 t ha^{-1}, NPK 200kg ha-^{1} and PM 5 t ha^{-1} + NPK 200 kg ha^{-1}) were assigned sub-plots. These treatments were replicated four times culminating into 12 treatment combinations. Irrigation rates did not seem to have significantly relative effect on growth and yield of okra across the cropping periods. Okra was tallest in plots treated with NPK + OM (91.30cm) irrespective of water level and plantings. NPK + OM incorporated plots recorded consistently higher okra fruit yield than those of other treatments (4.85, 4.89 and 4.57 t ha-1) for the first, second and third cropping period, respectively.***

Keywords: Okra, irrigation, organic manure, NPK, yield

1. Introduction

Okra *(Abelmoschusesculentus L)* is a herbaceous hairy plant of the Malvaceae family. It is valued for its edible green seed pods. Okra is grown primarily for the immature fruit, with a wide range of utilization and nutrition value. (Akinlade and Ogunlele 1982). Chief among these are its uses as vegetable with light vitamin C (other vitamin are A and B) content in making soup and stew. The high protein content of seed makes it a valuable food crop (Akinlade and Ogunlele, 1982). The stems contain a fiber for domestic purpose and other foods, thus preventing constipation. It is also important in the treatment of peptic ulcer (Miliken, 1996). Continuous cultivation of soil coupled with use of inorganic fertilizers, has been implicated in soil acidification, reduction of soil organic carbon and organic matter, nutrient imbalance, deficiency of secondary macro and micro-nutrients. (Adediran and Banjoko 2003; Osundara 2004). Due to this, many peasant farmers have resorted to the use of organic manure. The use of organic manure is beneficial to the soil in terms of alleviating soil acidity, improvement of soil physical properties and nutrient status. (Aro and Agwu, 2005; Ewulo, 2005). Irrigation is one of the farm management decisions within the grower's control. Although vegetable (Okra) farms receive large amounts of water from rainfall, this water often comes of times when there are no crops in the field. Therefore, irrigation is required during most seasons for successful vegetable production (Hochmuth, 2005). Irrigation and fertilizer are the two most important inputs in crop production. They have synergistic effects on crop growth and yields. Hence, this study was carried out to evaluate the effect of irrigation regimes and organic and inorganic fertilizers on growth and yield of Okra.

2. Materials and Methods

Study Area and Experimental Details

The study was conducted in Isampou area of Ekeremor Local Government Area of Bayelsa State, Nigeria. Bayelsa State is disserted centrally by longitude 60^{o} East and latitude 40^{o} North. The mean annual rainfall is variable but ranges between 2,000 to 2,703mm (FDRD, 1981; FAO 1984) and spread over 8 months of the year between the months of March and November, which coincide with wet season. The annual temperature ranges from an average minimum of 21.5^{o}C to an average maximum of 31.0^{o}C (FDRD, 1981).

Treatments

Factors A: Three water regimes

1. 20,000 l ha^{-1} day
2. 25,000 l ha^{-1} day
3. 30,000 l ha^{-1} day

Factor B: Organic Amendments

1. Control
2. NPK Fertilizers alone (200kg ha^{-1})
3. Poultry manure alone (5 t ha^{-1})
4. NPK Fertilizers (200kg ha^{-1}) + Poultry manure (5 t ha^{-1})

Soil Sampling and Analysis

A composite soil samples at the depths of 0-15cm and 15-30cm was taken randomly from selected points within each of the experimental site before and after cropping. These were air dried; passed through a 2mm sieve and analyzed for particle sizes; pH, total N, available P, organic matter, exchangeable K, respectively. All soil analysis was done according to procedures outlined by Tel and Rao (1982). The soil pH was done using the method described by Almu and Audu (2001).

Total N was determined by the semi micro kjeldah digestion method as modified by Tel and Rao (1982), while available P was determined by the Bray and Kurtz No. 1 method (Tel and Rao, 1982). Exchangeable K was extracted with neutral normal ammonium acetate buffered at pH 7.0 potassium (k). In the extract was measured by flame photo-meter (Tel and Rao, 1982). Organic carbon (C) was determined by wet dichromate digestion method (Walkey and Black, 1934). Organic matter was extrapolated from organic C by multiplying its value with Van Bemmeller constant of 1.723 (Allison, 1982).

Data Collection

Growth parameters: Plant height (cm) was monitored at 14, 21, 28, 35 and 42 DAP (cm) respectively.

Yield Components

Yield components that were collected to determine response pattern includes:- Fresh capsule weight, capsule length, and girth. Okra fruits were harvested at every three days and weighted fresh from the beginning to the last harvest.

Summation of these yields gave the total yields. At each harvest only uniform sizes of fruits were collected to ensure yield was not negatively affected.

Data Analysis

Data from the experiment were subject to analysis of variance (ANOVA). Observable differences amongst treatment means were separated using Duncan Multiple Range Test (DMRT) according to procedure of statistical Analysis System (SAS) (1999).

3. Results

Soil Physico-chemical properties of the experimental plot before cropping.

Composite soil samples at the depths of 0-15cm and 15-30cm were taken randomly from selected points within each of the experimental site before cropping. Results obtained from the soil analysis are presented in Table 1.

The soils were generally very strongly acidic with PH of 4.2 at the top horizon while the sub surface PH was 4.22. Soil analysis results indicated that textural class in the experimental site was silt loan irrespective of horizon.

Values of organic matter % total N, Available P, and Potassium in the experimental site were 4.20, 0.93, 0.02, 10.51 and 0.18 respectively. While corresponding values at the sub-surface horizon were 4.22, 0.90, 0.01, 9.06 and 0.11 for organic matter, % total N, available P (mg kg^{-1}) and potassium (cmol kg^{-1}), respectively.

Table 1: Chemical properties of soils of the experimental area before the cropping period

	Soil pH		Organic matter (%)		% total N		Available P(mg kg^{-1})		Potassium (cmol kg^{-1})		Textural class	
	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm
Initial	4.20	4.22	0.93	0.90	0.02	0.01	10.51	9.06	0.18	0.111	Silt loam	Silt loam

Okra Plant Height (CM)

Plant height of Okra at the different treatment groups varied significantly (P<0.05) (Fig. 1a, b & c). This observation was consistent for the three different cropping periods.

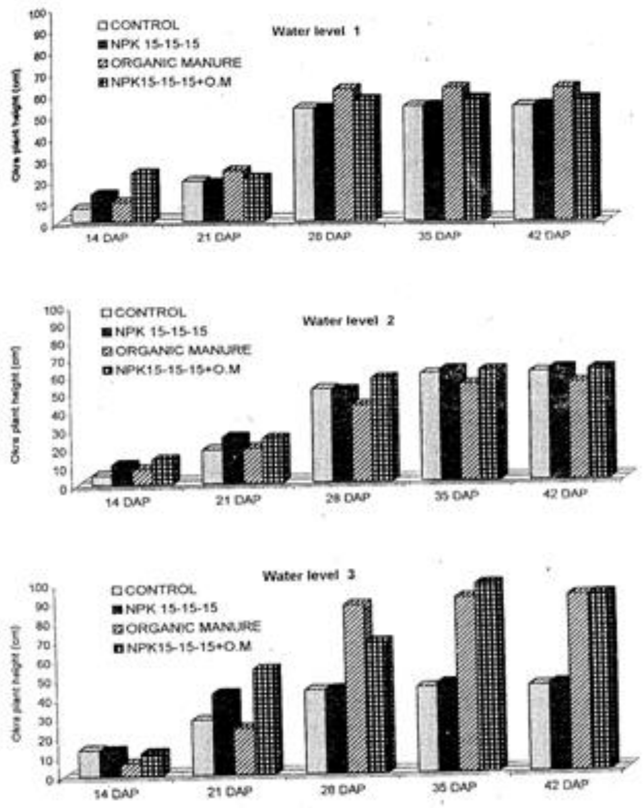
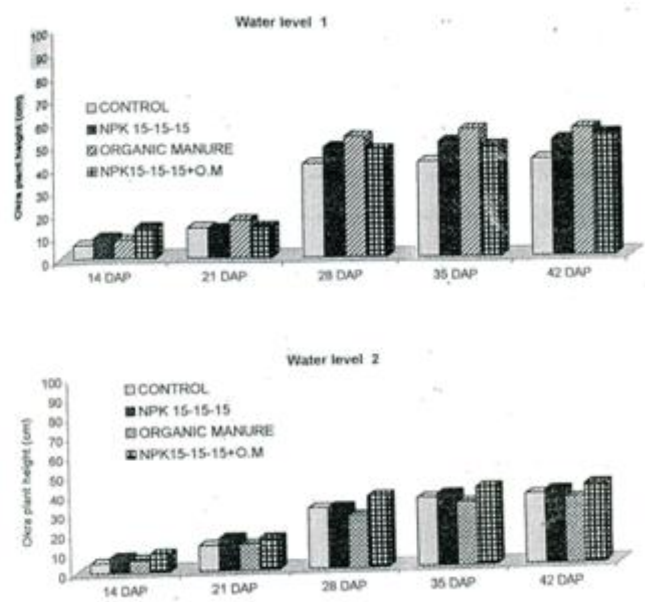


Fig 1 a:Effect of irrigation and soil amendments on Okra plant height at three water levels during year 1



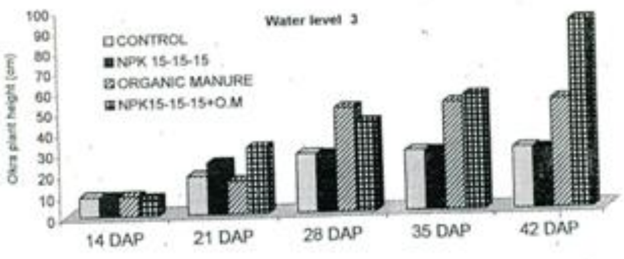


Fig 1b:Effect of irrigation and soil amendments on Okra plant height at three water levels during year 2

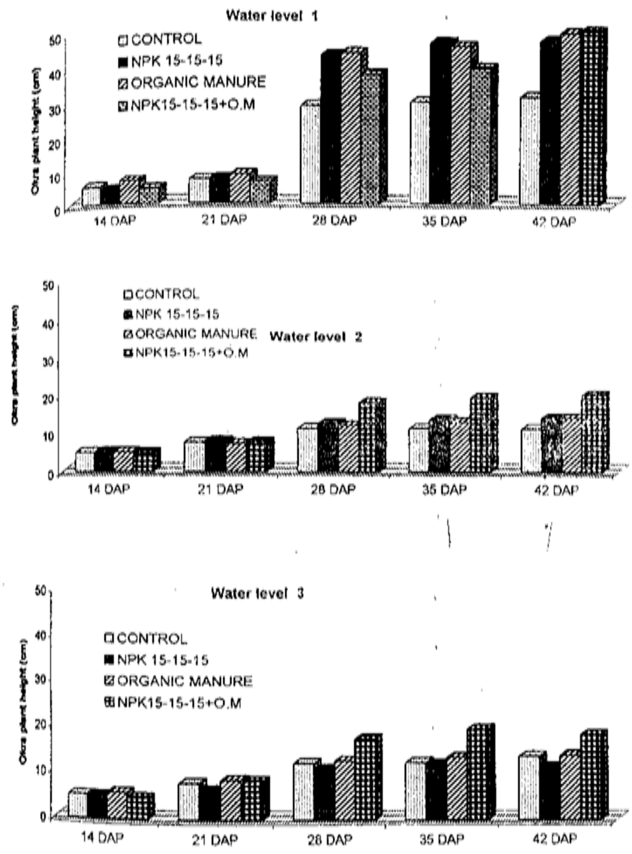


Fig 1 c:Effect of irrigation and soil amendments on okra plant height at three water levels during year 3

Okra Fruit Yield Due to Date of Harvest

At the first cropping period, at the first water level and at 77 DAP, NPK, OM and NPK + OM gave similar but highest fruit weights (0.59, 0.55 and 0.63 t ha^{-1}) respectively. (Figures 2a, b & c). This trend was repeated at the second water level, NPK + OM gave the highest Okra fruit yield (1.04, 1.41). At 105 DAP and at the first water level OM and NPK + OM had similar but highest fruit yield but these were closely followed by NPK and control which gave lowest and similar fruit yield. This trend was repeated by the third water level plots and at 91 DAPS. The lowest Okra fruit yield was recorded for control.

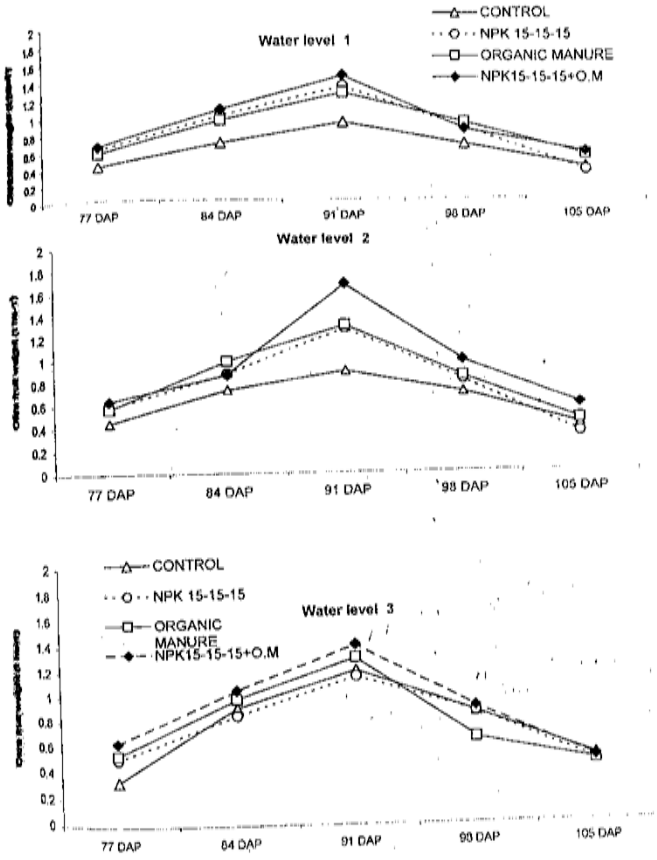


Fig 2 a:Effect of irrigation and soil amendments on Okra fruit yield at three water levels during year 1

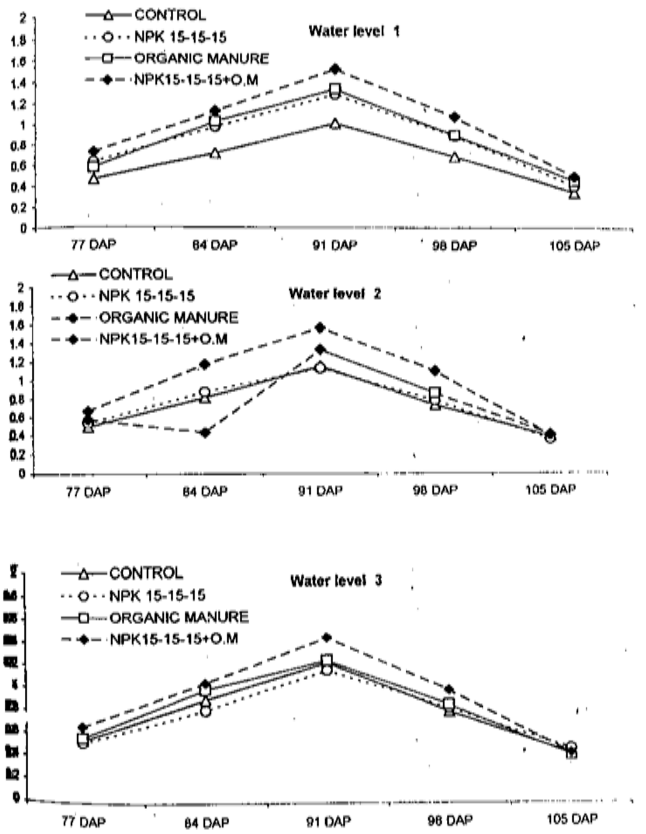


Fig 2 b:Effect of irrigation and soil amendments on okra fruit yield at three water levels during year 2

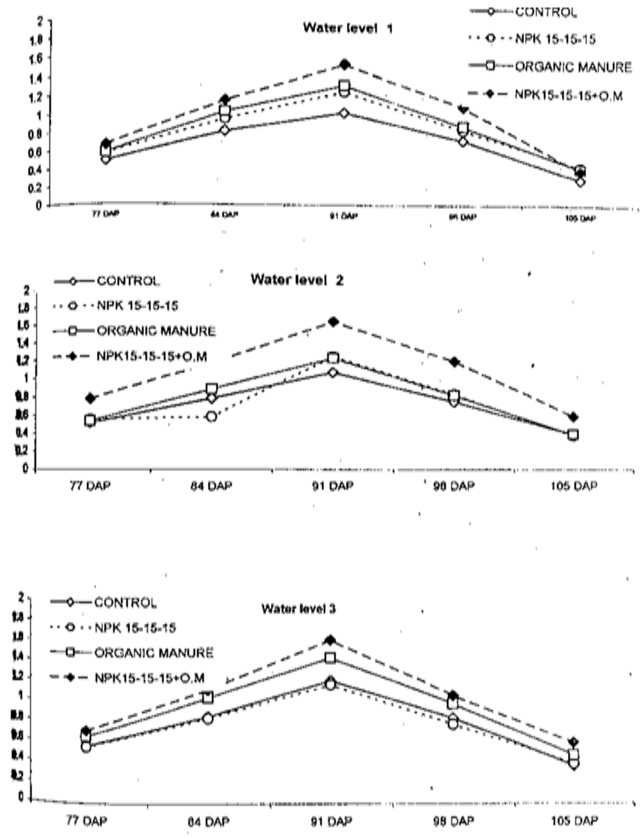
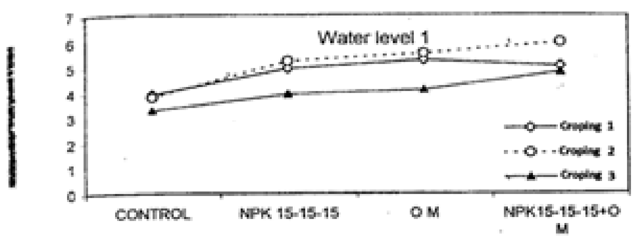


Fig 2c:Effect of irrigation and soil amendments on okra fruit yield at three water levels during year 3

Cumulative Okra Fruit Yield (t ha^{-1})

Okra fruit yield recorded at the first cropping period ranged from 2.92 to 4.84 t ha^{-1}, but significantly ($P<0.05$) higher Okra fruit yield was obtained consistently at plots that received NPK + OM (4.42, 4.84 and 4.43 t ha^{-1}) respectively for the first, second and third water levels respectively. (Fig. 3) These were generally closely followed by plots that received O.M except in the first water level plots.

During the second cropping periods Okra fruits yield ranged between 3.4 and 4.89. Again NPK + OM incorporated plots recorded consistently higher Okra fruit yield than those of other treatments (4.85, 4.89 and 4.57 t ha^{-1}) for the first second and third cropping period respectively. But in the third cropping period with yield ranging between 2.95 and 5.26 t ha^{-1}).



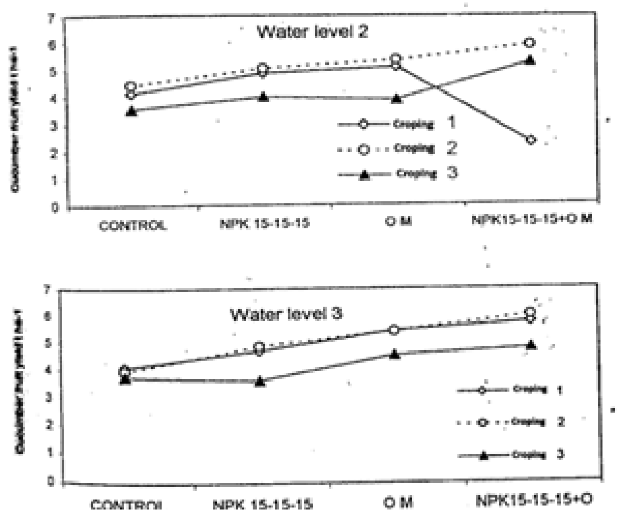


Fig.3:Effect of irrigation and soil amendments on cucumber fruit yield at three water levels

Okra Fruit Length (cm)

At the first cropping period, NPK + OM gave the longest Okra fruits (Table2a, b & c). But this was not higher than those from OM and control.

Table 2a: Effect of irrigation and soil amendment applications on okra fruit length during first cropping (cm).

	77 DAP	84 DAP	91 DAP	98 DAP	105 DAP	Overall Mean
CONTROL	5.88^{a}	6.13^{a}	8.30^{a}	7.25^{a}	7.1^{a}	6.90^{ab}
NPK	6.20^{a}	6.41^{a}	8.22^{a}	6.35^{a}	6.00^{a}	6.64^{b}
OM	5.63^{a}	6.90^{a}	7.88^{a}	6.93^{a}	7.10^{a}	6.89^{ab}
NPK+OM	5.93^{a}	6.57^{a}	7.30^{a}	8.10^{a}	8.00^{a}	7.18^{a}
Overall Mean	5.92^{d}	6.46^{c}	7.93^{a}	7.16^{b}	7.05^{b}	
Irrigation rate 25,000 l ha^{-1} day^{-1}						
CONTROL	4.75^{a}	5.35^{a}	1.00	5.60^{b}	6.75^{a}	6.53^{a}
NPK	6.08^{a}	6.58^{a}	7.08^{a}	7.33^{a}	6.7±^{a}	6.78^{a}
OM	6.23^{a}	6.60^{a}	7.05^{a}	7.30^{a}	7.00^{a}	6.84^{a}
NPK+OM	5.65^{a}	5.78^{a}	7.52^{a}	6.55^{ab}	6.53^{a}	6.41^{a}
Overall Mean	5.68^{c}	6.07^{c}	7.92^{a}	6.70^{b}	6.85^{b}	
Irrigation rate 30,000 l ha^{-1} day^{-1}						
CONTROL	5.25^{b}	5.63^{a}	6.50^{a}	7.28^{a}	5.54^{a}	6.04^{c}
NPK	5.37^{ab}	5.37^{a}	7.85^{a}	7.57^{a}	5.13^{a}	6.35^{bc}
OM	6.25^{ab}	6.95^{a}	7.03^{a}	7.08^{a}	6.53^{a}	6.86^{a}
NPK+OM	6.35^{a}	6.75^{a}	6.80^{a}	6.90^{a}	6.70^{a}	6.60^{ab}

Table 2b: Effect of irrigation and soil amendment applications on okra fruit length during second cropping (cm)

	77 DAP	84 DAP	91 DAP	98 DAP	105 DAP	Overall Mean
Irrigation rate 20,000 l ha^{-1} day^{-1}						
CONTROL	5.58^{*b}	4.47^{b}	6.00^{a}	6.23^{a}	4.7^{c}	5.40^{c}
NPK	5.24^{b}	7.70^{a}	6.00^{a}	6.84^{a}	6.06^{bc}	6.37^{a}
OM	6.90^{a}	5.27^{b}	6.40^{a}	7.65^{a}	7.70^{a}	6.78^{a}
NPK+OM	5.73^{ab}	5.05^{b}	0.00^{a}	6.37^{a}	6.30^{ab}	5.87^{b}
Overall Mean	5.86^{b}	5.62^{c}	6.13^{bc}	6.77^{a}	6.19^{b}	
Irrigation rate 25,000 l ha^{-1} day^{-1}						
CONTROL	0.00^{a}	5.15^{b}	4.30^{a}	4.20^{a}	4.7^{a}	5.59
NPK	7.00^{a}	7.05^{a}	5.78^{a}	5.00^{a}	5.27^{a}	6.03
OM	6.05^{a}	7.20^{ab}	5.23^{a}	5.05^{a}	5.53^{a}	5.82
NPK+OM	4.30^{a}	7.03^{a}	6.04^{a}	5.47^{a}	5.54^{a}	5.69
Overall Mean	5.78^{a}	6.63^{a}	5.30^{a}	4.83^{a}	5.27^{a}	
Irrigation rate 30,000 l ha^{-1} day^{-1}						
CONTROL	0.00^{a}	6.24^{a}	5.12^{b}	4.25^{d}	4.21^{a}	4.96^{c}
NPK	6.71^{a}	6.83^{a}	6.63^{ab}	5.50^{b}	5.21^{a}	6.38^{b}
OM	6.92^{a}	7.20^{a}	6.90^{a}	6.90^{b}	6.21^{a}	6.83^{a}
NPK+OM	6.58^{a}	7.40^{a}	5.90^{ab}	6.73^{a}	6.52^{a}	6.63^{ab}
Overall Mean	6.73^{ab}	6.91^{a}	6.39^{b}	5.85^{c}	5.54^{c}	

*** Denote Duncan Multiple Ranges Test (DMRT)**

Table 2 c: Effect of irrigation and soil amendment applications on okra fruit length during third cropping (cm)

	77 DAP	84 DAP	91 DAP	98 DAP	105 DAP	Overall Mean
Irrigation rate 20,000 l ha^{-1} day^{-1}						
CONTROL	0.00^{*a}	3.20^{a}	8.3^{a}	3.20^{c}	8.53^{a}	6.48^{ab}
NPK	0.00^{a}	6.22^{a}	8.22^{a}	6.35^{b}	7.03^{a}	6.96^{a}
OM	5.70^{a}	6.91^{a}	7.88^{a}	5.10^{c}	6.08^{a}	6.33^{b}
NPK+OM	5.80^{a}	6.57^{a}	7.30^{a}	8.10^{a}	7.17^{a}	6.39^{b}
Overall Mean	5.75^{d}	6.37^{c}	7.93^{a}	4.94^{c}	7.20^{a}	
Irrigation rate 25,000 l ha^{-1} day^{-1}						
CONTROL	2.80^{a}	5.50^{a}	6.00^{a}	3.00^{b}	8.00^{a}	5.58^{ab}
NPK	4.07^{a}	4.43^{a}	3.30^{c}	7.33^{a}	5.90^{a}	5.01^{b}
OM	4.71^{a}	5.37^{a}	6.60^{a}	9.40^{a}	5.20^{a}	5.82^{a}
NPK+OM	5.24^{a}	6.25^{a}	4.70^{bc}	5.60^{ab}	5.90^{a}	5.73^{a}
Overall Mean	4.21^{a}	5.39^{a}	5.15^{b}	6.67^{a}	6.25^{a}	
Irrigation rate 30,000 l ha^{-1} day^{-1}						
CONTROL	2.70^{a}	5.50^{a}	6.60^{a}	6.43^{a}	5.75^{ab}	5.40^{b}
NPK		5.00^{a}	4.55^{a}	5.12^{a}	7.00^{a}	5.42^{b}
OM	7.50^{a}	5.07^{a}	4.30^{a}	4.45^{a}	4.16^{a}	5.14^{b}
NPK+OM		8.80^{a}	6.40^{a}	7.15^{a}	5.15^{b}	6.88^{a}
Overall Mean	4.97^{a}	6.09^{a}	5.46^{a}	5.79^{a}	5.52^{ab}	

*Denotes Duncan Multiple Range Test (DMRT)

Okra Fruit Girth (cm)

Considering the first cropping, at the third water level and 77 DAP Okra girth was highest when NPK (7.80cm) and NPK + OM (7.53cm) were applied (Tables 4.8a, b & c). But these were similar to those from NPK + OM (7.53cm). At the 84 DAP OM and NPK + OM had similar but water Okra fruit girth respectively. While Okra fruit girth (6.7cm) in control plots was suppressed.

Table 3 a: Effect of irrigation and soil amendment applications on okra fruit girth during first cropping (cm)

	77 DAP	84 DAP	91 DAP	98 DAP	105 DAP	Overall Mean
Irrigation rate 20,000 l ha^{-1} day^{-1}						
CONTROL	5.80^{*a}	7.15^{a}	8.95^{a}	8.53^{a}	8.53^{b}	7.72^{b}
NPK	7.40^{a}	7.80^{a}	9.80^{a}	8.28^{a}	8.28^{d}	8.28^{a}
OM	7.00^{a}	8.28^{a}	8.68^{a}	8.35^{a}	8.35^{c}	7.85^{b}
NPK+OM	7.67^{a}	8.20^{a}	8.93^{a}	8.60^{a}	8.63^{a}	8.14^{a}
Overall Mean	6.42^{d}	7.80^{c}	7.09^{a}	8.45^{a}	8.23^{b}	
Irrigation rate 25,000 l ha^{-1} day^{-1}						
CONTROL	5.80^{a}	7.15^{a}	7.15^{a}	9.20^{a}	8.75^{a}	8.01^{a}
NPK	7.80^{a}	7.80^{a}	9.38^{a}	8.35^{a}	8.73^{a}	8.19^{a}
OM	5.63^{a}	7.30^{a}	9.77^{a}	8.27^{b}	7.28^{a}	7.65^{b}
NPK+OM	6.80^{a}	7.40^{a}	9.02^{a}	8.78^{a}	8.35^{a}	8.08^{a}
Overall Mean	6.19^{a}	7.46^{d}	9.35^{a}	8.65^{b}	8.28^{c}	
Irrigation rate 30,000 l ha^{-1} day^{-1}						
CONTROL	6.58^{b}	6.90^{b}	7.52^{a}	8.62^{a}	7.12^{a}	7.36^{b}
NPK	7.80^{a}	6.60^{a}	8.15^{a}	131 [illegible]^{a}	6.50^{a}	7.33^{b}
OM	7.58^{ab}	8.45^{a}	8.20^{a}	8.13^{a}	8.65^{a}	8.20^{a}
NPK+OM	7.53^{a}	7.80^{a}	8.00^{a}	8.23^{a}	5.93^{a}	7.56^{b}
Overall Mean	7.15^{a}	7.74^{b}	7.97^{ab}	8.16^{a}	7.05^{c}	

Table 3b: Effect of irrigation and soil amendment applications on okra fruit girth second cropping (cm)

	77 DAP	84 DAP	133 'AP	98 DAP	105 DAP	Overall Mean
Irrigation rate 20,000 l ha^{-1} day^{-1}						
CONTROL	7.70^{a}	8.00^{a}	8.05^{ab}	6.60^{b}	6.23^{b}	7.24^{b}
NPK	8.30^{a}	8.34^{a}	8.10^{ab}	10.20^{c}	7.76^{ab}	8.53^{a}
OM	7.77^{a}	9.18^{a}	9.20^{a}	7.13^{b}	10.5^{a}	8.75^{a}
NPK+OM	8.07^{a}	8.63^{a}	7.50^{b}	6.65^{b}	7.55^{ab}	7.68^{b}
Overall Mean	7.85^{ab}	8.53^{a}	8.21^{ab}	7.65^{b}	8.01^{ab}	
Irrigation rate 25,000 l ha^{-1} day^{-1}						
CONTROL	7.00^{a}	7.20^{b}	6.35^{a}	5.50^{a}	5.2^{d}	6.25^{c}
NPK	7.80^{a}	8.72^{a}	7.40^{a}	7.10^{a}	7.0^{b}	7.50^{b}
OM	7.07^{a}	8.65^{ab}	7.50^{a}	6.80^{a}	6.6^{c}	7.32^{b}
NPK+OM	7.02^{a}	9.13^{a}	7.92^{a}	7.47^{a}	7.41^{a}	7.79^{a}
Overall Mean	7.22^{b}	8.30^{a}	7.28^{b}	6.72^{c}	6.55^{c}	
Irrigation rate 30,000 l ha^{-1} day^{-1}						
CONTROL	8.16^{a}	8.27^{a}	7.08^{a}	6.28^{b}	7.28^{a}	7.41^{c}
NPK	8.90^{a}	8.63^{a}	8.13^{a}	6.45^{b}	7.60^{a}	7.94^{b}
OM	7.43^{a}	8.83^{a}	7.70^{a}	7.30^{b}	6.60^{a}	7.57^{bc}
NPK+OM	7.65^{a}	10.8^{a}	7.97^{a}	9.30^{a}	7.83^{a}	8.71^{a}
Overall Mean	8.04^{b}	9.13^{a}	7.72^{bc}	7.33^{c}	7.33^{c}	

*Denotes Duncan Multiple Range Test (DMRT)

Paper ID: ART20172758 DOI: 10.21275/ART20172758

Table 2 c: Effect of irrigation and soil amendment applications on okra fruit girth during third cropping(cm)

	77 DAP	84 DAP	91 DAP	98 DAP	105 DAP	Overall mean
Irrigation rate 20,000 l ha^{-1} day^{-1}						
CONTROL		5.00^{a}	9.20^{a}	7.00^{a}	9.53^{a}	7.44^{a}
NPK		0.00^{a}	6.55^{a}	8.28^{a}	6.45^{a}	7.08^{a}
OM	7.50^{*a}	9.27^{a}	5.43^{a}	8.35^{a}	7.57^{a}	7.62^{a}
NPK+OM	6.90^{a}	8.70^{a}	6.75^{a}	8.00^{a}	8.77^{a}	7.78^{a}
Overall Mean	7.10^{a}	7.86^{a}	6.98^{a}	7.90^{a}	7.84^{a}	
Irrigation rate 25,000 l ha^{-1} day^{-1}						
CONTROL		7.00^{a}	8.00^{b}	4.30^{a}	8.20^{a}	6.88^{a}
NPK	4.20^{a}	5.67^{a}	12.00^{a}	00^{a}	6.65^{a}	7.12^{a}
OM		7.17^{a}	7.65^{b}	6.65^{a}	6.20^{a}	6.92^{a}
NPK+OM	7.55^{a}	6.88^{a}	5.74^{c}	8.00^{a}	6.52^{a}	6.74^{a}
Overall Mean	5.38^{a}	6.68^{a}	8.35^{a}	6.51^{a}	6.90^{a}	
Irrigation rate 30,000 l ha^{-1} day^{-1}						
CONTROL	4.75^{a}	6.25^{a}	6.43^{a}	7.16^{a}	8.40^{a}	6.60^{ab}
NPK	0.00^{a}	6.85^{a}	3.85^{a}	6.21^{a}	8.00^{a}	6.23^{b}
OM	6.53^{a}	9.05^{a}	7.47^{a}	5.81^{a}	5.73^{a}	6.92^{ab}
NPK+OM	6.27^{a}	7.00^{a}	8.00^{a}	8.61^{a}	5.85^{a}	7.15^{a}
Overall Mean	5.85^{b}	7.29^{a}	8.44^{ab}	8.85^{a}	7.00^{a}	

* Denotes Duncan Multiple Range Test (DMRT)

4. Discussion

Okra is an annual herb growing to two meter tall (Rice et al, 1981). The shoot Support and display leaves enabling them to obtain needed light for photosynthesis and to have the vascular systems so that water may move up through the entire plant and the products of photosynthesis may move down. (Greulach, 1973). The efficiency of nutrient uptake by any plant can be obviously noticed from the rate at which the plant grows in height (Lary, 2004) Toiba (1993) stated that the strong correlation in the response to plant height and fruit yield to irrigation levels is because most of the Okra fruits are borne in the axils of the main stem, consequently anything which enhances stem elongation will enhance fruit yield.

At the first cropping period, at the first water level and during 14 DAP okra plant height was highest when grown in NPK + OM plots. This observable difference in plant height could be attributable in part to their genetic constitution and how the crops react to the effect of the treatments. This was nit higher in NPK plots.

Generally, okra plant heights were similar and highest at OM and NPK + OM plots. Adequate nutrient supply in the top soil encourages a vigorous and extensive root system. Stimulation of root development is related to N and P build up in the cells, which hastens division and elongation (John *et al.*, 2004). Okra plant heights were similar at all the treatments during the second water level at 14 DAP, and 28 DAP, and 42 DAP respectively and 14 DAP for the third water level. Fertilizer and irrigation shows synergistic effect of their combined application results to higher crop growth and yield, more than its sum of their independent effects. The positive and significant interactions between them favour their application to crops (Majumdar, 2006). The availability of nutrients and their uptake is highest when soil water is adequate and average at low tension.

At the second water level and during 21 DAP; the highest plant height was recorded for NPK plots. This value was similar from those OM and NPK + OM. This was statistically similar from values from NPK plots. At 28, and 42 DAP okra plant height was highest at OM. But these were not statistically higher for NPK + OM plots and during 42 DAP.

During the second cropping period and at the third water levels, okra plants heights were longest in NPK + OM and OM and NPK + OM plots respectively. However, during the second planting period, and at 40 DAP; NPK + OM had the greatest plant height. While the least plant height was from control plots. But during the 21, 28; 35 and 42 DAP okra plant height was greatest at OM plots consistently and respectively. At the second water level, NPK + OM consistently had the tallest okra plants respectively.

However, for 21 DAP, NPK + OM and NPK values were similar. For the third water level, NPK produced the highest plant height for 14, 21 DAP respectively. While NPK + OM had the highest plant height consistently for 28; 35 and 42 DAP respectively. At the first water level, OM had the highest plant height. At the second water level NPK + OM produced the highest plant height. But OM and NPK + OM had similar but highest plant height respectively. During the third cropping period and at the first water level tallest okra plant was record for plots that received OM at 14, 21, 28, 35 and 42 DAP respectively. But these values were similar in control plots at 14 DAP, NPK and control for 21 DAP NPK + OM for 28 DAP, NPK at 35 DAP and at NPK + OM and NPK plots for 42 DAP respectively. Okra plant height was longer in OM plots than plots that receive NPK + OM and control respectively.

At the third water level and at during the second planting period and first water level and at 40 DAP NPK + OM had the highest plot height while the least was from control. George *et al.* (1999) classified importance of organic manure in soils into two reasons, as it breaks down, it releases nutrients that crops can utilize and second, it improves the water – and nutrient holding capacity of the soils. But during 21, 28, 35, 42 DAP okra plant height OM produced tallest plants consistently.

At the second water level, NPK + OM consistently had the highest plant height respectively. However, for 21 DAP, NPK + OM and NPK values were similar. For the third water level, NPK, OM produced the highest plot for 14 and 21 DAP respectively. Fertilizer promotes profuse and deeper root system which enables crop plants to extract highest quantity of water and nutrients from deeper soil layers (Holmer, 1998). While Prasad and Singh (1998) reported that increasing supply of water encourages profuse root development that helps in greater uptake of nutrients for soil. While NPK + OM had the greatest height consistently for 28, 35 and 42 DAP respectively.

During the third cropping period, NPK + OM had the highest okra fruit yield ay 77, 84, 91, and 98 DAP, respectively. At 77 DAP' NPK+OM, similar but highest fruit yield. These values were similar to those from NPK + OM, but control gave the highest okra fruit yield. At the second water level NPK + OM had the highest fruit yield at 77, 84, 91, 98 and 105 DAP respectively. Control consistently had the lowest fruit yield. This trend was repeated at the third water level, but at 98 DAP values from OM and NPK + OM plots were similar. Generally, okra fruit yield gradually increased from harvest at 77DAP, and attained its peak at 98 DAP and reduced to the level at the first harvest. This trend was repeated in second and third water level plots and for the second and third cropping periods.

Rice *et al.*, (1987) predicted a fruit yield of 7-15 t ha-^{1}(1kg m^{2}) depending on its planting density. The pods should be picked while tender and immature (2 to 3 inches long for most varieties). Fig. 3 indicates okra fruit yield during the first period, and third cropping periods respectively, okra fruit yield recorded at the first cropping period ranged between 2.92 to 4.84 t ha^{-1}. But significantly higher okra fruit yield were obtained consistently from plots that received NPK + OM respectively for the first, second and third water levels respectively. This confirms IRRI (1994) which report best results are from the complementary use of mineral fertilizers and organic fertilizers. This may be explained by the more favourable soil micro climate for plant root development and functions. This in turn results in improved plant growth and yield (Vimala *et al.,* 2001). These were generally closely followed by plots that had OM except at the first water level plots.

During the second cropping period, okra fruit yield ranged between 3.4 to 4.89 t ha^{-1}. NPK + OM incorporated plots recorded consistently higher okra fruit yield than those of other treatments for the first, second and third cropping periods, respectively. The higher fruit yield irrespective of the test crop in the second cropping suggests enhanced mineralization and availability of P from the organic matter with time. This higher yield during the second cropping period was consistent for all the various OM and NPK + OM treated plots. Marjan and Lippert (2005) explained that OM tends to take more time to release their principal nutrients at the time the plant makes demand on them for its growth. But at the third cropping period okra fruits, the yield trend observed was repeated with yield ranging between 2.95 to 5.26 t ha^{-1}.

At the first cropping period, irrespective of period, NPK + OM had the greatest okra fruit length. But this was not higher than values from OM and control. For the second water level, NPK and OM had the greatest okra fruit length. However, these values were not higher than values from NPK + OM had higher okra fruit length than control. Irrespective of period, OM had higher okra fruit length. However, this was statistically similar to those from NPK + OM plots.

Considering the second cropping at 77 and 105 DAP, incorporated of OM gave higher okra fruit length. But these values were similar to values from NPK + OM respectively. At the second water level and at 84 DAP NPK; OM NPK + OM had higher okra fruit length. But at the third water level and at 56 DAP OM had higher okra fruit length. However, this was similar to those values from NPK and NPK + OM. While at 98 DAP NPK + OM had higher okra fruit length. Irrespective of period, OM had higher okra fruit length. This was however, similar to those from NPK + OM. A major benefit obtained from green manure is the addition of organic matter to the soil.

During the breakdown of organic matter by micro-organisms compounds are formed that are resistant to decomposition – such as gums, waxes and resins. The compounds – and the mycelia, mucus and slime produced by the micro-organisms help bind together soil particle granules, or aggregates (Preston, 2003) while explaining further that long term benefits are derived from the buildup of organic matter resulting in increased soil health.

Considering the third cropping period and at 98 DAP NPK + OM had the highest okra fruit length. Subbiah *et al.* (1985) obtained higher yields of tomato and eggplant with combined use of FYM and fertilizers. The integrated use of urea and poultry manure also resulted in a higher nutrient uptake (Jose *et al.,* 1988; Jablonska (1990). At the third water level and at 105, DAP NPK and OM had higher okra fruit length. Irrespective of period, for first water level NPK had higher okra fruit length. At the second water level OM and NPK + OM had higher okra fruit length. While at the third water level; NPK + OM had the greatest okra fruit length.

Considering the first crop, at the third water level and 77 DAP okra girth was higher when NPK and NPK + OM were applied. But these were similar to those from NPK + OM. At the 84 DAP; OM and NPK + OM had similar but bigger okra fruits respectively, while control suppressed okra fruit girth. Generally, at the first water level incorporation of NPK and NPK + OM had increased okra fruit girth respectively. At the second level NPK and NPK + OM had similar but highest okra fruit girth respectively. But at the third water require OM had biggest okra fruit girth. All other treatment groups had similar but restricted okra fruit girth.

At the second cropping period and at 91 DAP; OM increased okra fruit girth. This was similar to those from control and NPK respectively. At 98 DAP NPK had the highest okra fruit, while 77 DAP, OM had highest okra fruit girth. This was similar from those from NPK and NPK + OM amended plots.

For the second water level and at 77 DAP, NPK and NPK + OM had the biggest okra fruits respectively. But these were similar to those from OM treatment group. The superiority of OM could be further attributed to its slow nutrient release factor. Organic manures ability to enhance the desirable soil physical conditions for plant growth and its ability to better the soil environment against undesirable fluctuations. But Baldwin (2001) warned that farmers may manage crop nutrients and soil fertilization to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil or water by plant nutrients, pathogenic organisms, heavy metals or residues of prohibited substances.

5. Conclusion and Recommendation

This study showed that water could be harnessed from a river during the dry season to irrigate the farmland and produce crops. A comparison of irrigation rates of 20,000; 25,000 and 30,000 I ha^{-1} did not show any significant effect consistently throughout the study. We therefore conclude that through irrigation is a must for any farming activity to be carried out at Isampou during the dry season, water level exceeding 20,000 l ha^{-1} may not be necessary. In fact, further studies are warranted with water level less than 20,000 l ha^{-1}.

The application of organic and inorganic fertilizers led to greater yields of okra when compared with the application of either poultry manure or NPK alone. It is worthy of note that apart from rain-fed agriculture, farmers can grow crops, especially vegetables which are in high demand during the dry season by using fresh water from rivers to irrigate their land.

References

[1] Allison, F.E. (1982). Soil organic matter and its role in crop production. El. Sevier, Amsterdam pp 317.
[2] Almu, H. and M.D. Audu (2001). Physico-chemical properties of soil of Awa irrigation project area of Kano State. Department of soil science, Kano University of Technology, Wedi in: proceedings of the 27th Annual conference of soil science of Nigeria P. 1325, November 5-9, 2001.
[3] Aro, O.A and Agwu J. A. (2005). Effect of animal manure on selected soil chemical properties. J. soil Sci. 15:14-19.
[4] Balwin, K.R (2001). Soil fertilizer for organic farming. Final draft copy 05/12/01. The ATTRA product Ozark mountains on the University of Arkkansa's Campus sayetteville, P.O. Box 3657 Fayetteville, Arkansas, 72702.
[5] Ewulo, B. S. (2005). Effect of poultry dung and cattle manure on chemical properties of clay and sandy clay loam soils. J. Anim, Vet, Adv, 4:839-841.
[6] FAO (Food and Agriculture Organization) (1994) Year Book Vol. 4 FAO *Rome Italy, P. 122-127.*
[7] FDRD (Federal Department of Rural Development (1981). Rivers State Accelerated Development Area Program Preparation report. November, 1981.
[8] Greulach, V. A (1973) Plant function and structure. Macmillan.
[9] George, E. B. Davbie G, W. Terry Kelley and Wayne M.C (1999). Growing vegetables organically. Bulletin 1011. University of George College of Agriculture and Environmental service Co-operative Extension Service pp 10.
[10] Hochmutch G.J. (2005). Nitrogen management for vegetable production in Florida. http/edis/ifas.utl.edu.kv.
[11] Holmer R. J (1998) sustainable vegetable production for small farmers on problem soils in the highland of Bukianon for fresh marketing and processing. Ph.D thesis Institute for vegetable science Tel Muchen, Germany Publisher Ver lag. Dr. Korac Hamburg, Germany.
[12] IRRI (International Rice Research Institute (1993). Potential of organic materials for soil improvement R. R. Hessei in: International Rice Research Institute Los Banos, Laguna Philippines P. 632.
[13] Jablonska, C. R. (1990) Straw as an organic fertilizer in cultivation of vegetable plants Horticultural Abstracts 63:244.
[14] John M (2004) sustainable Agriculture. 2nd Edition CSIRO Publishers. Victoria 3066. Australia.
[15] Jose D, K. Geshanmugarela and S. Thamburaj (1988) Studies on the efficiency of organic Vs inorganic form of nitrogen in bimgal. *Indian Journal of horticulture 45:100-103.*
[16] Larry S. H. (2004). Comparative cost of teepee. Trellised Vs Non-Trellised cucumber production in: American Samoe Technical Report No. 33 Bulletin 1178 Apl 2000. Cooperative Extension work, acts of May 8 and June 30th 1914, Univ. of Awrgia College of Agricultural and Environment Science and the U.S. Department of Agricultural Comparative P. 48.
[17] Majundar, D. K. (2006) irrigation water management principles and practices, published by Asoke K. Gbosh, Practice of India Riwale United, New Delhi 11000.
[18] Marjan, K. and B. Lippet (2005). Home and Garden Information Centre. Adopted from South Carolina Garden Training manual E. (678 Clemson).
[19] Milikan, S. (1996). Okra green and cone sauté. Journal of okra physiology, 12:45-71.
[20] Prasad, B. and A.P Singh (1998). Charges in soil properties with long term use of fertilizer, line and farm yard manure. J. Indian Soc. Soil Science 28:465-468.
[21] Rice R.P, H.D. Tindal and L.W. Rice (1987). Fruit and vegetable production in African Institute of Technology. Macmillan Publishers Ltd. PP 277-289.
[22] Statistical Analysis system (1999). Statistical user guide version 64 education Cary, NCSAs Institute.
[23] Subbiah, K, S. Sundararjans, Misthuswami, and R Rerumai (1985) Responses of tomato and brinjal to varying levels of FYM and Macro Nutrients under difficult fertilizer status of soil. *South Indian Horticulturalist 33:198-205.*
[24] Tel, D. and P.V. Rao (1982): Automated and Semi automated methods series No. 7 international institute of tropical agriculture, Ibadan Nigeria.
[25] Toiba, K.M (1993). The earth summit and Africa's development. A lecture delivered at the international institute of tropical agriculture. Ibadan, Nigeria.
[26] Vimale P, Ting, C.C. Salbiah, H., Ibrahim, B. and Ismail. 2001. Biomass production and nutrient yields of four green manures and their effects on the yield of cucumber. J. Top. Agric. and Food Sci. 27:47-55.
[27] Walkley, A and I.A Black (1934). Different Methods for determining soil organic matter and proposed meditations of the chromic and titration methods. Soil sci. 37:29-38