EFFECT OF INTEGRATED ORGANIC AND INORGANIC NUTRIENT SOURCES ON THE GROWTH AND YIELD OF SNAKE GOURD (*Trichosanthes anguina* L.)

AKASH KUMAR BISWAS

DEPARTMENT OF HORTICULTURE

SHER-E-BANGLA AGRICULTURAL UNIVERSITY, DHAKA-1207

DECEMBER, 2021

EFFECT OF INTEGRATED ORGANIC AND INORGANIC NUTRIENT SOURCES ON THE GROWTH AND YIELD OF SNAKE GOURD (*Trichosanthes anguina* L.)

BY

AKASH KUMAR BISWAS
REGISTRATION NO.: 13-05722
PHONE: +8801747777981
EMAIL: akashkumar5722@gmail.com

A Thesis
Submitted to Faculty of Agriculture
Sher-e-Bangla Agricultural University, Dhaka-1207
I partial fulfillment of the requirements
For the degree of

MASTER OF SCIENCE
IN
HORTICULTURE
SEMESTER: JULY-DECEMBER, 2021

Approved By:

Prof. Dr. Khaleda Khatun	**Prof. Dr. Tahmina Mostarin**
Department of Horticulture	Department of Horticulture
SAU, Dhaka	SAU, Dhaka
Supervisor	**Co-Supervisor**

Prof. Dr. Khaleda Khatun
Chairman
Examination committee

DEPARTMENT OF HORTICULTURE
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that the thesis entitled ***"EFFECT OF INTEGRATED ORGANIC AND INORGANIC NUTRIENT SOURCES ON THE GROWTH AND YIELD OF SNAKE GOURD (Trichosanthes anguina L.)"*** *submitted to the Department of Horticulture, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTERS OF SCIENCE (M.S.)*** *in* ***Horticulture****, embodies the result of a piece of bonafide research work carried out by* ***AKASH KUMAR BISWAS****, Registration No.* ***13-05722*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

June, 2021

Dhaka, Bangladesh

(Prof. Dr. Khaleda Khatun)
Department of Horticulture
Sher-e-Bangla Agricultural University, Dhaka

DEDICATED TO
MY
BELOVED PARENTS

ACKNOWLEDGEMENTS

*The author seems it a much privilege to express his enormous sense of gratitude to the **Almighty God** for there ever ending blessings for the successful completion of the research work.*

*The author wishes to express his gratitude and best regards to his respected Supervisor, **Professor Dr. Mst. Khaleda Khatun**, Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, for his continuous direction, constructive criticism, encouragement and valuable suggestions in carrying out the research work and preparation of this thesis.*

*The author wishes to express his earnest respect, sincere appreciation and enormous indebtedness to his reverend Co-supervisor **Prof. Dr. Tahmina mostarin** for his scholastic supervision, helpful commentary and unvarying inspiration throughout the research work and preparation of the thesis.*

The author feels to express his heartfelt thanks to all the teachers and staff members of the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, for their co-operation during the period of the study.

The author feels proud to express his deepest and endless gratitude to all of his course mates and friends to cooperate and help him during taking data from the field and preparation of the thesis. The author is very much thankful to Sher-e-Bangla Agricultural University Research System (SAURES) to provide the fund of this research.

The author expresses his heartfelt thanks to his beloved parents and Brothers and all other family members for their prayers, encouragement, constant inspiration and moral support for his higher study. May Almighty bless and protect them all.

The Author

CONTENT

CHAPTER	TITLE	PAGE NO.
	ACKNOWLEDGEMENTS	**I**
	CONTENT	**ii-iv**
	LIST OF FIGURES	**V**
	LIST OF TABLES	**Vi**
	LIST OF APPENDICES	**Vii**
	LIST OF PLATES	**Viii**
	LIST OF ACRONYMS	**ix**
	ABSTRACT	**X**
CHAPTER I	**INTRODUCTION**	**1-4**
CHAPTER II	**REVIEW OF LITERATURE**	**5-24**
CHAPTER III	**MATERIALS AND METHODS**	**25-35**
3.1.	Experimental site	25
3.2.	Characteristics of soil	25
3.3.	Climatic condition of the experimental site	25
3.4.	Agro-ecological region	26
3.5.	Experimental details	26
3.5.1.	Planting materials used in the experiment	26
3.5.2.	Experimental treatments	26
3.5.3.	Design and layout of the experiment	27
3.6.	Land and pits preparation	27
3.7.	Seed treatment	27
3.8.	Seed sowing	27
3.9.	Inorganic and organic fertilizer application	29
3.10.	Intercultural operations	29
3.10.1.	Gap filling	29
3.10.2	Weeding	29
3.10.3.	Mulching	30
3.10.4.	Irrigation and drainage	30

Content (Cont'd)

CHAPTER	TITLE	PAGE NO.
3.10.5.	Vine management	30
3.10.6.	Trellis	30
3.10.7.	Pest control	30
3.11.	Harvesting	30
3.12.	Data collection	31
3.12.1.	Vine length at vegetative stage (m)	31
3.12.2.	Vine length at flowering stage (m)	31
3.12.3.	Vine length at fruiting stage (m)	31
3.12.4.	Number of leaves plant^{-1} at vegetative stage	31
3.12.5.	Number of leaves plant^{-1} at flowering stage	31
3.12.6.	Number of leaves plant^{-1} at fruiting stage	31
3.12.7.	Leaf length (cm) at vegetative stage	31
3.12.8.	Leaf length (cm) at flowering stage	32
3.12.9.	Leaf length (cm) at fruiting stage	32
3.12.10.	Leaf breadth (cm) at vegetative stage	32
3.12.11.	Leaf breadth (cm) at flowering stage	32
3.12.12.	Leaf breadth (cm) at fruiting stage	32
3.12.13.	Number of primary branches plant^{-1} at fruiting stage	32
3.12.14.	Days required to 1st Male flowering	32
3.12.15.	Days required to 1st Female flowering	32
3.12.16.	Number of male flowers plant^{-1}	33
3.12.17.	Number of male flowers plant^{-1}	33
3.12.18.	Days to first fruit set	33
3.12.19.	Days to first fruit harvest	33
3.12.20.	Fruit length (cm)	33
3.12.21.	Fruit Diameter (cm)	33
3.12.22.	Number of fruits plant^{-1}	33
3.12.23.	Individual fruit weight (kg)	33
3.12.24.	Fruit yield plant^{-1} (Kg)	33
3.12.25.	Fruit yield plot^{-1} (Kg)	34

Content (Cont'd)

CHAPTER	TITLE	PAGE NO.
3.12.26.	Fruit yield hectare^{-1} (t)	34
3.13.	Statistical analysis	34
3.14.	Economic analysis	34
3.14.1.	Analysis for total cost of production of snake gourd	34
3.14.2.	Gross income	34
3.14.3.	Net return	35
3.14.4.	Benefit Cost Ratio (BCR)	35
CHAPTER IV	**RESULTS AND DISCUSSION**	**36-50**
4.1.	Vine length (cm)	36
4.2.	Number of leaves plant^{-1}	37-38
4.3.	Leaf length at vegetative stage (cm)	38-39
4.4.	Number of branches at flowering stage	39-40
4.5.	Days required to first male flowering	40
4.6.	Days required to first female flowering	40
4.7.	Number of male flowers plant^{-1}	41
4.8.	Number of female flowers plant^{-1}	42
4.9.	Days required for first fruiting	43
4.10.	Number of fruits plant^{-1}	44
4.11.	Fruit length (cm)	45-46
4.12.	Fruit diameter (cm)	46
4.13.	Average fruit weight (gm)	46
4.14.	Yield plot^{-1} (kg)	47
4.15.	Yield (t ha^{-1})	48
4.16.	Economic analysis	48
4.16.1.	Gross return (Tk.)	48
4.16.2.	Net return	49
4.16.3.	Benefit cost ratio	50
CHAPTER V	**SUMMARY AND CONCLUSION**	**51-52**
	REFERENCES	**53-61**
	APPENDICES	**62-68**

LIST OF FIGURES

FIGURE NO	TITLE	PAGE NO.
1	Field layout of the experiment in the Complete Block Design (CRD)	28
2	Effect of different levels of organic and inorganic fertilizers on number of male flowers plant^{-1} of snake gourd plant (*Trichosanthes anguina* L.).	42
3	Effect of different levels of organic and inorganic fertilizers on number of female flowers plant^{-1} of snake gourd plant (*Trichosanthes anguina* L.).	43
4	Effect of different levels of organic and inorganic fertilizers on number of fruits plant^{-1} of snake gourd plant (*Trichosanthes anguina* L.).	45
5	Effect of different levels of organic and inorganic fertilizers on Yield plot^{-1} (kg) of snake gourd plant (*Trichosanthes anguina* L.).	48
6	Effect of different levels of organic and inorganic fertilizers on Yield (t ha^{-1}) of snake gourd plant (*Trichosanthes anguina* L.).	49

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1	Effect of different levels of organic and inorganic fertilizers on vine length (cm) at different growth stages of snake gourd plant (*Trichosanthes anguina* L.)	37
2	Effect of different levels of organic and inorganic fertilizers on number of leaves plant^{-1} at different growth stages of snake gourd plant (*Trichosanthes anguina* L.).	38
3	Effect of different levels of organic and inorganic fertilizers on leaf length at vegetative stage (cm) and no. of branches at flowering stage of snake gourd plant (*Trichosanthes anguina* L.).	39
4	Effect of different levels of organic and inorganic fertilizers on no. of branches at flowering stage and days required for first flowering of snake gourd plant (*Trichosanthes anguina* L.).	41
5	Effect of different levels of organic and inorganic fertilizers on days required for first fruiting and fruit length (cm) of snake gourd plant (*Trichosanthes anguina* L.).	44
6	Effect of different levels of organic and inorganic fertilizers on fruit diameter (cm) and average fruit weight (gm) of snake gourd plant (*Trichosanthes anguina* L.).	47
7	Cost and return of snake gourd cultivation as influenced by different levels of organic and inorganic fertilizers	50

LIST OF APPENDICES

APPENDIX	TITLE	PAGE NO.
I	Map showing the experimental site	62
II	Characteristics of Sher-e-Bangla Agricultural University soil is analysed by Soil Resources Development Institute (SRDI), Khamar Bari, Farmgate, Dhaka.	63
III	Monthly record of annual temperature, rainfall, relative humidity, soil temperature and sunshine of the experimental site during the study period from March 2020 to July 2020 (Site: Dhaka)	64
IV	Analysis of variance of the data on vine length (cm) at different growth stages of snake gourd as influenced by different levels of organic and inorganic fertilizers application.	64
V	Analysis of variance of the data on number of leaves plant^{-1} at different growth stages of snake gourd as influenced by different levels of organic and inorganic fertilizers application.	64
VI	Analysis of variance of the data on leaf length at vegetative stage (cm), no. of branches at flowering stage, days required to first male flowering and days required to first female flowering of snake gourd as influenced by different levels of organic and inorganic fertilizers application.	65
VII	Analysis of variance of the data on number of male flowers plant^{-1}, number of female flowers plant^{-1}, days required for first fruiting and number of fruits plant^{-1} of snake gourd as influenced by different levels of organic and inorganic fertilizers application.	65
VIII	Analysis of variance of the data on fruit length (cm), fruit diameter (cm) and average fruit weight (gm) of snake gourd as influenced by different levels of organic and inorganic fertilizers application.	65
IX	Analysis of variance of the data on yield plot^{-1} (kg) and yield (t ha^{-1}) of snake gourd as influenced by different levels of organic and inorganic fertilizers application.	66

LIST OF PLATES

PLATE NO.	TITLE	PAGE NO.
1	Pictorial presentation of different operations during land preparation A. Seed sowing in experimental filed B. Fertilizer application in experimental plot.	67
2	Pictorial presentation of different growth stages of snake gourd in experimental plot.	68
3	Pictorial presentation of harvested snake gourd fruit from different experimental plots	69

LIST OF ACRONYMS

Acronyms	Full word
AEZ	Agro ecological zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
Cm	Centimeter
CV	Coefficient of Variation
DAS	Days After Sowing
et al.	And others (*et alibi*)
FAO	Food and Agriculture organization
g	Gram
ha	Hectare
HI	Harvest Index
Kg	Kilogram
kg ha^{-1}	kg per hectare
LSD	Least Significance Difference
m^2	Square Meter
MS	Master of Science
no.	Number
%	Percent
pH	Hydrogen ion concentration
$plant^{-1}$	per plant
SAU	Sher-e- Bangla Agricultural University
SMI	System of mustard intensification
SRDI	Soil Resources and Development Institute
t ha^{-1}	Ton per hectare
RCBD	Randomized Complete Block Design

EFFECT OF INTEGRATED ORGANIC AND INORGANIC NUTRIENT SOURCES ON THE GROWTH AND YIELD OF SNAKE GOURD (*Trichosanthes anguina* L.)

ABSTRACT

The experiment was conducted during the period from March 2020 to July 2020 to investigate the effect of integrated nutrient management on the growth and yield of snake gourd (*Trichosanthes anguina* L.) at the Horticultural Farm of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh. The experiment was laid out in the Randomized Complete Block Design with three replications. A total of 11 nutrient combinations used in this experiment i.e. T_0: control (No organic fertilizer and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1}+ B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}+ Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}. All growth, reproductive and yield parameters *viz.* vine length, number of leaves $plant^{-1}$, leaf length, leaf breadth, days required to 1st male and female flowering, number of male and female flowers $plant^{-1}$, days to 1st fruit set, days to 1st fruit harvest, fruit length, fruit diameter, number of fruits $plant^{-1}$, individual fruit weight, fruit yield $plot^{-1}$ and fruit yield $hectare^{-1}$ showed positive effect with different nutrient combinations. The highest yield (50.10 t ha^{-1}) of snake gourd was recorded from T_{10} treatment while the lowest yield (14.72 t ha^{-1}) was recorded from T_0 treatment. The highest BCR (1.9) of snake gourd cultivation was recorded from T_{10} treatment while the lowest BCR (1.01) was recorded from T_0 treatment.

CHAPTER I
INTRODUCTION

Snake gourd (*Trichosanthes anguina* L.) belongs to Cucurbitaceae family, sub-family Cucurbitoidac, tribe Tricosanthcac, (Chakrabarti, 1982). Snake gourd is an annual vegetable crop, climbing vine, providing both long and short fruits (Mahale *et al.* 2018). Snake gourd bears fruit that is consumed as vegetable. Snake gourd is very important vegetable crop in Bangladesh and it can be grown throughout the year. Snake gourd is found wild in South and Southeast Asia including Bangladesh, India, Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia and Southern China (Podder *et al.* 2010). It is inherent to Northern Australia and got naturalized in Florida, islands of Indian and Pacific oceans and parts of Africa (Ravindran, 1971). Commonly it is known as Chinese Cucumber, Gudda Bean, Club Gourd, Serpent Cucumber, Serpent Gourd, Snake Tomato, Snake Gourd, Viper's Gourd, Chichinda and Padwal (Seshardi, 1988). In Bangladesh it is mainly grown in homestead area and field during summer season. It has caught a conspicuous situation among the vegetables because of it all year development and nutritive worth. In addition, it has enormous fare probability due to its incredible keeping quality (Podder *et al*. 2010).

Snake gourd is fat free, low in calories and good to include in weight-loss regular diets. According to dietary perspective, snake gourd can be considered as nourishment rich natural product vegetable. It is good in the source of vitamins and minerals contents like iron, calcium, phosphorus, and a substantial amount of carotene, trace of riboflavin, thiamin and niacin. It contains impressive measure of protein (0.5%), fat (0.3%), minerals (0.5%), fiber (0.5%) and sugars (3.3%) (Gopalan *et al.* 1985). The plant has high content of chemical constituents such as carotenoids, flavonoids and phenolic acids (Podder *et al.* 2010). Snake gourd offers fiber that supports digestive health, treats diabetes, detoxifies body and eradicates cholesterol from the body. It is useful to maintain healthy heart and liver. It also counteracts respiratory problems, acidity, cancer and worms. It provides relief from arthritis, promotes hair growth, boost immunity and promotes weight loss. The fruit becomes bitter in tastes as it reaches maturity, but it does contain a reddish pulp that is used in Africa as a substitute for tomato. Snake gourd has been found to help lessen the effects of diabetes. Snake gourd roots are used for expelling worms.

The total land area of Bangladesh is about 8505278.14 hectares where 453653 ha total area was used for vegetable cultivation and total vegetable production was 4.587 million ton (BBS, 2019). More than 1.42% area was under summer vegetable cultivation in Bangladesh where >3.43% area was under cultivation of snake gourd. A total 7861 ha area was under cultivation of snake gourd and total production was 46057 ton in Bangladesh (BBS, 2021). In Bangladesh, cultivable land is decreasing every year. There is an acute shortage of vegetables in early kharif seasons. Snake Gourd can fulfill this shortage of summer vegetables.

The development, yield and nature of snake gourd are to a great extent impacted by the utilization of manures. The development of snake gourd requires an abundant gracefully of plant supplements. Lateritic soil is most appropriate for development of cucurbitaceous family crop (Ghayal, 2016). The traditional method of farming and less use of organic manure reduces the quality of Snake gourd. For increasing the productivity an economical fertilizer package need to be formulated which can provide all the essential elements through both organic and inorganic sources to get good quality, produce with higher production, keeping the production cost at sustainable level of an average farmer. Fertilizer management is one of the important factors that contribute in production and yield of any crop. The most essential nutrients for vegetative growth of the crop are nitrogen, phosphorus, potassium and sulpher. For maximum vegetative growth of plant required a sufficient amount of N is necessary. Adequate supply of nitrogen favors the transformation of carbohydrates into proteins and promotes the good amount of foliage (Rai, 1992). Arora and Satish (1989) reported that N and P increase the number of female flower of sponge gourd (*Luffa aegyptiaca*). Phosphorus (P) plays a vital role in several key physiological process viz. photosynthesis, respiration, energy storage and transfer, cell division and cell enlargement. It stimulates root growth, blooming, fruit setting and seed formation (Memon, 1996). Nason and Mc. Elrory reported that K has an important role in balancing physiological activities like respiration, photosynthesis, chlorophyll development and water content of lime. Lingaiah *et al.* (1988) observed highest bitter gourd yield when combined application of N: P_2O_5: K_2O at 80: 30: 20 kg ha^{-1}. S also play a vital role in the longevity of seed in storage and better performance of seedling in the field and helps to increase the uptakes of N and P significantly (Singh *et al.* 1995). It has been noted that the majority of Bangladesh's soil are sulpher deficient

(De Datta, 1981). It is well known that micronutrients deficiencies are one of the major limiting factors for crop production in most tropical woody deep soils (Tadano, 1985). Among the micronutrient elements, Zn, B, Mg plays an important role directly and indirectly in improving the growth, yield and quality fruit of plants. Singh and Singh (2004) reported that Zn application increase chlorophyll content and raise the concentration of Ca, Mg, K and P in tissue, whereas decrease Na content. Thus Zn modified elemental composition of plant tissue favorably accelerates plant growth and yield. Boron (B) increases the stability of plant cells and is involved in the reproductive process of plants and its inadequacy is often associated with sterility and malformation of reproductive organs (Katyal and Randhawa, 1983). Magnesium (Mg) is the central core of the chlorophyll molecule in plant tissue. Thus id Mg is deficient the shortage of chlorophyll results in poor and stunted plant growth. Mg also helps to activate specific enzyme system. Although Mg is an essential element for plant growth, its use in a fertilizer program receives only minor emphasis in Bangladesh.

Using of organic fertilizers has been proved to have satisfactory effects on soil structure and texture (Hamma *et al.* 2012). Use of organic fertilizers is essential for its proper growth and development. Recently, organic farming is appreciated by vegetable consumers as it enhances quality of the produce (Rekha and Gopalakrishnan, 2001). Nutrients are applied to the soil through organic and inorganic means. Indiscriminate use of inorganic fertilizer is beneficial to cause deterioration of soil texture and structure, and hinders microbial activity and finally decreases soil fertility and production. Application of organic manure in crop production is therefore important for satisfactory yield. On an average well rotten cowdung contains 0.5 % N, 0.2 % P_2O_5 and o.5% K_2O (Yawalkar *et al.* 1984). In Bangladesh cowdung is used as organic manure. Faces from poultry farms are used as an organic fertilizer, particularly for soils with low nitrogen levels (Mishra and Bongan, 1986). Fresh poultry manure can aid plant growth and yield since it contains 0.8 % K, 0.4-0.5 % P and 0.9-1.5 % N. Poultry manure contains high amount of N and P when it decomposed (Moral *et al.* 2009). Singh and Amberger, (1991) reported that poultry manure contains highest concentration of N, P and K of any animal manures. On the other hand, vermicompost is a nutritious organic fertilizer that is rich in micronutrients, helpful for soil microorganisms, plant growth hormones and enzymes (N: 2-3 %, K: 1.85-2.25 % and P: 1.55-2.25 %). Vermicompost expands microspores,

which improves soil air water concentrations and benefits plant growth (Marinari *et al.* 2000). Nagavallemma *et al.* (2004) concluded that vermicompost provides all nutrients in soil in readily available form and also increase uptake of nutrients by plants. Earthworms consume various organic wastes and reduce the volume by 40–60%.

Thus, in this respect integrated nutrient management (INM) plays a vital role to maintain soil fertility, to bring stability, sustainability in agricultural production and also avoid over dependence on chemical fertilizers. Efficient use of integrated plant nutrient supply system is a pre-requisite for achieving continuous advances in biological productivity of vegetable crops in ecologically sustainable manner (Sreenivas *et al.* 2000). So in this regard for sustainable production integrated nutrition management is very important for quality production and yield. Therefore, the present experiment was undertaken to find out the combined effect of organic manure, chemical fertilizers and bio fertilizers in an integrated manner for yield maximization in bottle gourd and study the effect of integrated nutrient management on the quality characters of bottle gourd fruit. However, very limited research was conducted In this regard. Considering the above facts, the present experiment has been undertaken with the following objectives:

i. To find out the effect of integrated nutrient management on the flowering, growth and yield of snake gourd.

ii. To observe the combined effect of organic and inorganic fertilizer on the maximum growth and yield of Snake gourd.

CHAPTER II

REVIEW OF LITERATURE

Research on snake gourd is very limited. However, research works on snake gourd and other members of the Cucurbitaceae family and other related crops in respect of fertilizer management, plant growth regulators, time of sowing, plant spacing, vine pruning, fruit retention, etc. have been earned out in different parts of the world. Literatures related to the present study have been reviewed below.

Organic manures supply important plant elements, both macro and micro. Apart from supplying plant nutrients, they favor aggregation of fine soil particles, thereby promoting good soil structure and it is also essential for healthy development of soil micro-organisms which further carry out biochemical transformations, play active role in decomposing organic matter and help in releasing the essential plant nutrients (Suresh and Pappaiah, 1991).

Orluchukwu and Amadi (2022) conducted an experiment at the University of Port Harcourt Teaching and Research farm, Port Harcourt, Rivers State, Nigeria from April to August, 2019 on the effects of organic and inorganic fertilizers on the growth and yield of cucumber (*Cucumis sativus* L). The research was done in a randomized complete block design with four treatments and replicated four times. The treatments include control (no application), NPK 15:15:15, spent mushroom substrate, and poultry manure. Data collected were, vine length (plant height), number of leaves, and stem girth, leaf area, length of pod, weight of pod. Results showed that plots with poultry manure had significant effect on vine length, number of leaves, leaf area at 6 weeks after planting (WAP) and 8 WAP. The highest number of fruits was 9.0 per plot or 15,000 per hectare and highest fruit weight was 1.59 kg/plot (2,650 kg/ha) which were higher than NPK 15:15:15 (0.47 kg/plot or 783.33 kg/ha) and spent mushroom substrate (0.19 kg/plot or 316.67 kg/ha). Hence, the use of poultry manure as organic source for the cultivation of cucumber in the study area would be recommended.

Khanum *et al.* (2021) conducted a experiment at the research field of Agricultural Research Station, Rajbari, Dinajpur during rabi season of 2018-19 and 2019-20 to develop a profitable and economic fertilizer dose and optimum planting time for Squash and to increase the productivity and yield. Two different dates of planting *viz.*

15 November and 30 November considered as factor A and different organic manures viz., vermicompost, poultry manure and cow-dung considered as factor B. The experiment was laid out in randomized complete block (RCB) design (Factorial) with three replications. Organic manures and planting time showed significant effects on most of the parameters. In case of organic manures, highest individual fruit weight (1707.50 g) and fruit yield (32.43 t ha^{-1}) was recorded from vermicompost whereas the lowest fruit weight (1233.17 g) and fruit yield (23.52 t ha^{-1}) was recorded from cow-dung application. In case of planting time, the highest individual fruit weight (1747.11 g) and fruit yield (29.61 t ha^{-1}) was recorded from 15 November planting date whereas the lowest fruit weight (1196.44 g) and fruit yield (25.86 t ha^{-1}) was recorded from 30 November planting date. For combination, highest individual fruit weight (2153.66 g) and fruit yield (34.06 t ha^{-1}) were recorded from vermicompost with 15 November planting date while the lowest individual fruit weight (1105.33 g) and fruit yield (20.56 t ha^{-1}) were recorded from cow-dung with 30 November planting date. Vermicompost with 15 November planting date was found suitable for total productivity and economic return of the system.

Okee *et al.* (2020) conducted a study to ascertain the effect of organic manure on growth of cucumber. The experiment was conducted at Kogi State University Nursery Farm during the 2020 dry season. The experiment was laid in a randomized complete block design with 4 treatments and five replications. Four rates of well decomposed cattle manure levels (0 t ha^{-1}, 5 t ha^{-1}, 10t ha^{-1}, and 20t ha^{-1}) were used. Organic matter content, soil pH, soil texture, inherent N, P and K for the four soil types and nutrient quality for manure were evaluated prior to crop establishment. Cattle manure, poultry droppings and saw dust were analysis for its nutrient composition (0.95% N, 0.17% P, 0.63% K, 1.52% Ca, 4.7% Zn and a pH of 6.7) before application. This trial clearly indicated that production of cucumber can be enhanced by combined application of poultry manure. Farmers are therefore advised to use the highest rate of combined application of 10,000 kg ha^{-1} of poultry manure.

Mkhabela *et al.* (2020) carried out a field experiment at the Horticulture Farm, University of Eswatini during the 2019/2020 planting season to assess the effectiveness of biocompost and vermicompost on the vegetative growth and fruit yield of baby marrow. Significant differences in plant height, number of leaves, flowers, fruits and fruit length among the different fertilizer treatments were observed.

Baby marrow plants in the control had the highest plant height (57.9 cm) and number of leaves (25.0). The highest leaf length (28.6 cm) was obtained from plants supplied with 10.0 tons/ha vermicompost and leaf width (29.8 cm) was achieved from plants fertilized using 7.5 tons/ha biocompost. More flowers (18.0) were observed from the control plants with less flowering (12.0) from plants provided with 5.0 tons/ha biocompost. The highest fresh fruit mass (20.4 g) was attained from plants grown using 7.5 tons/ha vermicompost, while the lowest (16.0g) was recorded from those fertilized using 5.0 tons/ha biocompost. The highest dry matter content (65.1%) was obtained from plants cultivated using 5.0 tons/ha biocompost. For maximum baby marrow fresh fruit yield, vermicompost at 7.5 tons/ha should be used.

Esmaielpour *et al.* (2020) conducted a experiment to determine the effects of vermicompost on the growth, yield and nutrient contents of cucumber grown under the glasshouse conditions. This experiment was performed in completely randomized design with five replications. The base medium (control) was selected to be a mixture of 75% farm soil with 25% sand that had been substituted with 0, 10, 20, 30, 40, 50 and 60% by volume of cow manure vermicompost. The highest leaf area, stem numbers, stem and root dry weight, fruit yield, and chlorophyll content were resulted from substitution of base medium with 10 and 20% vermicompost that were significantly different from control ($P \leq 0.05$). Further, increase in the vermicompost content of the base medium, reduced the stem height, leaf area, stem dry weight, root dry weight, and chlorophyll content. Plant yield was the lowest in the 50% and 60% vermicompost medium. Shoot macro and micro-nutrient content such as nitrogen, phosphorus, potassium, calcium, iron, zinc, manganese, and copper increased significantly in response to the increase in vermicompost ratio from 0 to 60%, therefore, the lowest and the highest of these nutrient contents were observed in the control and 60% vermicompost, respectively, and even in some cases, nutrients content reached the toxic levels.

Tahir *et al.* (2019) conducted an experiment in the Botanical Garden of the Department of Biology of Kaduna State University to study the effects of Organic and Inorganic Fertilizer on the growth and yield of *Cucumis sativus* L. The seeds for the experiment were locally sourced. Four (4) days after transplanting, a rate of 2ton/ha, 4ton/ha, 6ton/ha poultry manure was applied. Highest plant height of 33cm was recorded with 6ton/ha compared to the control which had 11.5cm. However, highest

number of leaves was recorded with 4ton/ha and was followed by the 6ton/ha. The best stem girth of 1.8cm was observed with 4ton/ha while the control had 0.88cm stem girth. Excellent vigor was produced by the 6ton/ha, while the lowest vigor was observed with the 2ton/ha. The best plant yields of was observed with 6ton/ha compared with the control which had the least performance.

Law and Osaigbovo (2018) conducted an experiment in February to June of 2015 and 2016 at the Experimental Farm, Faculty of Agriculture, University of Benin, Benin City, Nigeria to evaluate the effects of cattle and poultry manures on the productivity of cucumber (*Cucumis sativus* L.) and their post-harvest effect on the chemical properties of the soil. The experiment was in a 2 x 4 split plot arrangement fitted into a randomized complete block design with three replications with the organic fertilizers (cattle and poultry manures) as main treatments the application rates (0, 5, 10 and 15 t ha^{-1}) as sub plots. Data were collected on growth and yield variables of cucumber. The results revealed that organic fertilizer types had no effect ($P>0.05$) on growth, yield and post-harvest variables except vine girth. The rate of application had effect on growth, yield and post-harvest soil chemical properties ($P<0.05$). The highest fruit yields were 3.99 and 3.66 t ha^{-1} observed on plants treated with 15 and 10 t ha^{-1} of organic fertilizer, respectively. Based on convenience and cost, 10 t ha^{-1} of poultry manure is thereby recommended for farmers.

Kumar *et al.* (2017) conducted an experiment at Kethanur village, Palladam taluk, Tirupur District, Tamil Nadu to assess the effect of various organic sources on productivity and quality of snake gourd. The experiment was conducted in randomized block design using eleven treatments and replicated thrice. The treatments used were; Enriched farmyard manure, vermicompost, groundnut cake, neem cake are applied alone or combined with foliar application of panchagavya (3%) and 3G extract (3 per cent), farmer practices of organic cultivation and control (no manure/foliar spray). The results revealed that significantly enhance the growth, yield (20.15 t/ha) and quality parameters of snake gourd performance by vermicompost + panchagavya spray (3 %) followed by application of vermicompost + 3G extract (3 per cent) and EFYM + 3G extract spray @ 3 % than control. Based on the results, these studies suggest that it is advantageous to application of vermicompost along with foliar spray of panchagavya or 3G extract (1 %) as an effective on growth and

yield in order to improving the quality parameters of snake gourd under organic cultivation system.

Khan *et al.* (2017) conducted a field trial to study the effect of poultry manure levels (0, 10, 15, 20 t ha^{-1}) on the growth and yield of cucumber (*Cucumis sativus* L.) cultivars (Desi 36 Days, Market more, Poinsett 76 and S. Green) at Horticultural Research Farm, University of Agriculture, Peshawar, Pakistan. The experiment was carried out in randomized complete block design (RCBD) with three replications. Both factors showed significant variations in growth and yield parameters. Results concluded that early days to flowering (36.5), Maximum vine length (179.8 cm), number of branches $plant^{-1}$(4.5), numbers of leaves $plant^{-1}$ (75.0), leaf area (147.8 cm^2), fruit length (19.5 cm), fruit diameter (4.9 cm), number of fruits $plant^{-1}$(5.6), average fruit weight (174.8 g) and yield (38.3 t ha^{-1}) were observed in plants supplied with poultry manure @ 20 t ha^{-1}. Among cultivars, S. Green was best in all parameters except days to flowering. The S. Green cultivar showed significantly increased vine length (169.5 cm), number of branches $plant^{-1}$ (4.4), numbers of leaves $plant^{-1}$ (73.5), leaf area (138.8 cm^2), fruit length (17.7 cm), fruit diameter (4.8 cm), number of fruits $plant^{-1}$ (4.8), average fruit weight (177.4 g) and yield (33.2 t ha^{-1}). Early days to flowering (36.6) were noted in cultivar Desi 36 Days. The interactions were found non-significant in all parameters except average fruit weight. The application of poultry manure @ 20 t $ha^{-1}$to S. Green cultivar induced high growth and yield. The S. Green cultivar can be commercially cultivated in Peshawar valley with the application of poultry manure @ 20 t ha^{-1} for high growth and yield.

Eifediyi *et al.* (2017) reported that the organic amendments were as environmentally friendly fertilizers and resulted in higher production in watermelon as compared to the inorganic amendment (NPK fertilizer) in terms of positive effects on soil structural properties.

Kumar *et al.* (2017) reported that long term sustainability of organic nutrition in vegetable crops (tropical) depended on the quantity and quality of organic manures applied, crop yield, quality and price of the tinda produce.

Hafez *et al.* (2016) carried out a field study during summer seasons of 2013 and 2014 at the Experimental Farm, Faculty of Environmental Agricultural Sciences, Arish University, Egypt. It aims to study the effect of organic fertilizer sources (cow manure

"CM"; chicken manure (ChM); pressed olive cake (POC); compost "Comp"} and two bio-fertilizer sources (Bio-1 and Bio-2) plus without biofertilizer on summer squash (*Cucurbita pepo* L.) *cv* “Askandrany” under ELArish conditions. The experiment included 12 treatments and the experimental design was split plot design with three replications. Organic fertilizers were randomly distributed in the main plots (four sources), while, sub plots contained three bio treatments (without bio, Bio-1 and Bio-2). The obtained results indicated that cow manure treatment gave the highest values of number of fruits/plant, mean fruit weight, yield/plant and yield/fed., also, cow manure x Bio-1 treatment gave the highest value in case of average fruit weight/plant, while, cow manure x Bio-2 treatment gave the superior values in cases of number of fruits/plant, yield/ plant and yield/fed., in both seasons. Results of the interaction between organic and bio fertilizers, chicken manure and Bio-1 produced the highest value of TSS%.

Arfan-ul-Haq *et al.* (2015) revealed in bitter gourd that when the effect of organic materials was compared; it was evident that poultry manure produced the highest yield.

Okoli and Nweke (2015) revealed that poultry manure as organic manure and its combination is a good source of soil amendment since it influenced the growth and yield components of cucumber.

Shafeek *et al.* (2015) described highly substantial results that organic manure at a higher level (3.2 ton/fed.) improved plant growth, fruit yield, physical and chemical characters of fruit quality of cantaloupe plants.

Ojo *et al.* (2014) stated that the use of organic fertilizer in cultivation of watermelon could be applied as an alternative to mineral fertilizer, although it was cost effective but difficult to procure and cannot substantially amends the physical delicateness of the soil.

Natsheh and Mousa (2014) showed that the application of compost improved the soil characteristics; increased soil productivity, organic matter content and reduced water requirements for cultivation of cucumber.

Hong-mei *et al.* (2014) reported that application of organic fertilizer increase total production, vitamin C, protein, sugar content of cucumber fruit.

Ghorbani *et al.* (2013) specified that the application of 20 t ha^{-1} cattle manure with no-chemical fertilizer is an appropriate approach for organic production of summer squash which produces greater yield with high seed oil contents.

Mehdizadeh *et al.* (2013) conducted an experiment to evaluation the vegetative growth yield quantity of tomatoes as affected by different organic fertilizers. The results showed that adding of organic fertilizers at rate of 20 ton ha^{-1} significantly increased tomato growth and yield compared to control (no fertilizer application). Also obtained results demonstrated that tested treatments could be arranged in decreasing order as follows: municipal waste compost > poultry manure > cow manure > sheep manure > no fertilizer. They also reported that compost and poultry manure had a synergistic effect on both fresh and dry weights of tomato shoots and roots and related to other treatments. As a general result using of organic fertilizers especially in composted form had positive effect on soil health and fertility, which consequent proliferation yield in long term can be expected

Clementina (2013) stated that organic manure is the best to be used as an alternative to the inorganic manure (NPK) for the production of cucurbits.

Ikeh *et al.* (2012) carried out an investigation to find out the growth and yield of cucumber (*Cucumus sativus* L.) in response to application of goat dung and poultry dropping rates was investigated in 2010 and 2011. The experiment was laid out in randomized complete block design replicated three times in a split plot arrangement. The main plot treatment was organic manure source (goat dung and poultry dropping) while organic manure rate, 0, 2, 4, 6 and 8t/ha constituted the sub-treatments. Results revealed that organic manure application would enhance growth and yield of cucumber. There was no significantly ($p<0.05$) different between application of goat dung and poultry dropping on growth and yield parameters except on leaf area. The result also showed significantly ($p<0.05$) different among the manure rates irrespective of manure source. Application of poultry dropping performed best in fresh fruit yield 7.66 and 7.73t/ha in 2010 and 2011 respectively while goat dung produced 6.81 and 6.82t/ha in 2010 and 2011 respectively. The application of 8t/ha of poultry manure produced fresh fruits of 11.25 and 11.29t/ha in 2010 and 2011 respectively while goat dung at 8t/ha rate produced 9.53 and 9.69t/ha of fresh fruit in 2010 and 2011 respectively.

Jianming *et al.* (2008) reported that the highest vitamin C content, lower nitrate content in cantaloupe fruits and increased P and K mineralization was obtained by using chicken and pigeon manure composts.

Rasool *et al.* (2008) obtained that vermicompost at rate of 15 t ha^{-1} significantly improve growth, yield of bitter gourd compared to other treatments (0, 5, 10 t ha^{-1}). It also increased EC of fruit juice and percentage of fruit dry matter up to 30 and 24%, respectively. The content of K, P, Fe and Zn in the plant tissue increased 55, 73, 32 and 36% relate to untreated plot respectively.

Makinde *et al.* (2007) reported that since ancient times, farmyard manure has been used as a soil conditioner and its advantage has not been completely utilized due to the large amounts needed to meet the nutritional needs of crops.

Kannan *et al.* (2006) examined that application of recommended quantities of vermicompost to different field crops has been stated to decline the requirement of chemical fertilizers without affecting the crop yield. Application of 100% nitrogen as vermicompost enumerated the increase plant height and number of branches per plant of tomato and it was significantly superior over supplementation of 100% N through urea and FYM alike trend was found in most plant height of basmati rice at maturity with the application of vermicompost and it was on par with treatment receiving azolla at the rate 1.5 ton ha^{-1}. A progressive advance in plant height and leaf area key of soybean was observed with the conjunctive use of 75% N through vermicompost and remaining 25% N through inorganic fertilizer and was originate at par with 100% N through vermicompost alone. Additive benefit determined from vermicompost submission (Govindan and Thirumurugan, 2005) might be attributed to its higher nutrient substances and their availability to crop.

Ayoola and Adeniran, (2006) concluded that the need for renewable forms of energy and reduced cost of fertilizing crops, have revived the use of organic manures worldwide.

Arancon *et al.* (2004) applied organic fertilizer produced commercially from cattle manure, market food waste and recycled paper waste to tomatoes (*Lycopersicon esculentum*), bell peppers (*Capsicum anuumgrossum*), and strawberries (*Fragaria spp.*). The result revealed that the marketable tomato yields in all vermicompost-treated trial were consistently better than yields from the inorganic fertilizer-treated

plots. Leaf areas, numbers of strawberry suckers, numbers of flowers, shoot weight and total marketable strawberry yields increased considerably in plots treated with vermicompost compared to those that received chemical fertilizers only besides significant increases in shoot, leaf areas and total and marketable fruit yields of pepper plants from plots treated with vermicomposts. The author indicate that improvement in plant growth and increases in fruit yield could be due to large proliferations in soil microbial biomass after vermicompost applications, leading to production of microbial hormones or humates in the vermicompost acting as plant-growth regulators independent of nutrient supply.

Nagavallemma *et al.* (2004) concluded that vermicompost provides all nutrients in soil in readily available form and also increase uptake of nutrients by plants. Earthworms consume various organic wastes and reduce the volume by 40– 60%. Each earthworm weighs about 0.5 g to 0.6 g eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in per day. These worm castings have been examined for chemical and biological properties. The moisture content of castings ranges between 32% and 66% and the pH is around 7.0. The worm castings contain higher percentage of both macro and micronutrients than the garden compost. Soil available N increased significantly with increasing levels of vermicompost and highest quantity of N uptake was obtained at 50% of the recommended fertilizer rate plus 10 t ha^{-1} vermicompost. Vermicompost reduces C:N ratio and retains more nitrogen. The prolonged immobilization of soil nitrogen by the vermicomposted organic manures was attributed to the recalcitrant nature of its C and N composition. It proliferations macro pore space ranging from 60 6 to 500 μm, resulting in increased air-water relationship in the soil which favorably affects plant growth and development. The application of vermicompost favorably affects soil pH, microbial population and soil enzyme activities.

Parthasarthi and Ranganathan, (2002) reported that vermicomposting is a bio-oxidation and stabilization methods of organic material that associated the joint action of earthworms and microorganisms. The earthworms are the agents which help for turning, fragmentation and aeration. It also increase N_2 fixation by both nodular and free living N_2 fixing bacteria and thus increase plant growth. Vermicompost has been demonstrated as one of the cheapest source of nitrogen and other essential elements for better nodule formation and yield particularly in legumes. Such plants can meet up

their N needs through both biological nitrogen fixation (symbiosis) and native nitrogen in the soil.

Ghasem *et al.* (2014) concluded that application of 14 t ha^{-1} vermicompost or 50 t ha^{-1} cow manure was advisable to produce more cucumber yield compared with chemical fertilizer and other treatments.

El-Shakweer *et al.* (1998) reported that organic manures can sustain cropping systems through better nutrient recycling and improvement of soil physical attributes.

Nair *et al.* (1997) compared the microorganisms associated with vermicompost with those in conventional composts. They establish that the vermicompost had much larger populations of bacteria (5.7 x 107), fungi (22.7 x 104) and actinomycetes (17.7 x 106) compared with those in traditional composts. The outstanding physiochemical and biological attributes of vermicompost make them excellent ingredients as additives to greenhouse container media, organic fertilizers or soil amendments for horticultural crops.

Improvement in environmental conditions and public health are important reasons for advocating increased use of organic materials (Ojeniyi, 2000). However, because it is bulky, the cost of transportation and handling constitute a constraint to its use by peasant farmers.

Farmyard manure release nutrients slowly and steadily and activates soil microbial biomass (Ayuso *et al.* 1996; Belay *et al.* 2001).

The use of inorganic fertilizer has not been helpful under intensive agriculture because of its high cost and it is often associated with reduced crop yields, soil degradation, nutrient imbalance and acidity (Kang and Juo, 1980; Obi and Ebo, 1995).

Tahir *et al.* (2019) conducted an experiment in the Botanical Garden of the Department of Biology of Kaduna State University to study the effects of Organic and Inorganic Fertilizer on the growth and yield of *Cucumis sativus* L. A rate of 25g/ha, 50g/ha, 75g/ha of NPK was also applied and a control. Results revealed that 25kg/ha of NPK had the highest plant height of 20.5cm while the lowest plant height of 13cm was observed with 75kg/ha, compared to the control which had 11.5cm. The 25kg/ha gave the highest number of leaves followed by the 50kg/ha and 75kg/ha which both had the lowest number of five (5) leaves. Similarly, 50kg/ha had the

highest stem girth of 1.2cm while the lowest stem girth was observed with the control which had 0.7cm stem girth. The best vigour was recorded with the 25kg/ha compared to the control which had the least vigour. Also, highest plant yield was recorded with 25kg/ha and the lowest plant yield was observed in the control.

Arshad *et al.* (2014) concluded that the application of NPK as fertilization resulted in early flowering, fruiting with maximum number of fruits per plant, more weight, length of fruit and higher yield in cucumber.

Oga and Umekwe (2013) suggested that NPK fertilizer significantly affected the vine length, flowering, fruiting and marketable yield in watermelon.

Eifediyi and Remison (2009) stated that the growth and yield attributes of cucumber including the vine length, number of leaves per plant, number of branches, leaf area, number of fruits per plant, fruit length, fruit girth, fruit weight per plant, fruit number per plant and total yield per hectare had increased significantly with increase in inorganic fertilizer application up to the maximum level.

Jilani *et al.* (2009) stated that application of NPK fertilizer (100-50-50) in cucumber induced earliness in flowering and fruiting, least days for flowering, fruit setting, maturity, maximum fruit per plant, fruit length, fruit weight and yield.

Song *et al.* (2006) concluded that nitrogen, phosphorus and potassium nutrients uptake by cucumber increased with advanced fertilizer rate.

Umamaheswarappa *et al.* (2005) reported that nitrogen application showed a significant effect on number of days required for initiation of earliness in flowering, number of days required for first fruit set whereas phosphorus application also exhibited positive effect on flower initiation, development whereas potassium application had no substantial effect on flowering, fruit set of cucumber in *cv.* Poinsette.

Boonmanop (1997) studied the influences of N, P and K fertilizers on seed yield and seed quality of bitter gourd. Bitter gourd was grown and treated with the combination of 3 rates of nitrogen (0, 15 and 30 kg N rai^{-1}), 3 rate of phosphorus (0, 10 and 20 kg P_2O_5 rai^{-1}) and 2 rates of potassium (0 and 10 kg K_2O rai^{-1}) fertilizers. The results showed that N, P and K fertilizers had no significant effects on the first bloom of male

and female flower (earliness), total number of fruits, weight per fruit, number of seeds per 7 square meter (6 plants), number of seeds per fruit, total seed weight and 100 seeds weight. However, the high rates of N, P and K gave the highest germination (92.9 %) and germination index (23.2) and the best combination was 30, 20 and 10 kg N, P_2O_5 and K_2O rai^{-1}, respectively.

Islam (1995) conducted an experiment with five levels of NPK such as 0-0-120-0-0, 120-120-60, 240-0-0 and 240-120-60 kg ha^{-1} on bitter gourd seed production. He observed that plots treated with N alone at the rate of 240 kg ha^{-1} improved the vegetative growth of bitter gourd as manifested by an increase number and length of vines, diameter of stem, length and diameter of leaves. The inclusion of P and K to N significantly reduced the above parameters, except the number of lateral vines and diameter of stem, which remains unaffected. However, application of NPK significantly increased the number of fruits per plant, size and weight of fruits and the fruit yield compared to plots treated with N alone. The increase in fruit yield due to the application of P and K was 11.35 t ha^{-1} at 240 kg N ha^{-1}. The same trend of result was noted for seed yield and quality where plants fertilized with 240-120-60 kg ha^{-1} produced the highest yield due to greater number of filled seeds per fruit which were bigger and heavier than the seeds produced from other treatments. Moreover, the above treatment produced seeds with the highest percentage of germination (99.00%) and seed vigor index (20.03%).

Naik and Srinivas (1992) in trials conducted at the Division of Vegetable Crops, Indian Institute of Horticultural Research, Bangalore, Karnataka, India with *cv.* Pusa Sawani to observe the influence of nitrogen and phosphorus fertilization on seed crop of okra in the rainy seasons of 1985 and 1986 on a sandy loam soil with low available N and P. N was applied at 50, 100, 150 and 200 kg ha^{-1} and P at 30, 60 and 90 kg P_2O_5 ha^{-1}. Half of the N, all the P and 40 kg K_2O ha^{-1} were applied before sowing; the rest of the N was applied as a top dressing 30 days after sowing. The highest seed yields were obtained with 200 kg N ha^{-1} (13.00 and 11.25 q ha^{-1} in 1985 and 1986 respectively) and 90 kg P_2O_5 ha^{-1} (11.89 and 10.71 q ha^{-1} during 1985 and 1986 respectively). Other parameters (fruit length, number of fruits $plant^{-1}$, number of seeds $fruit^{-1}$ and 1000 seed weight) were also highest with the highest rates of fertilizer application.

Arora and Satish (1989) observed that N and P increase the number of female flower of sponge gourd (*Luffa aegyptiaca*) *cv.* Pusa Chikni during the summer and rainy seasons. The plants received N at 0-75 Kg ha^{-1} and P at 40 Kg ha^{-1}. Then highest number of female flower was obtained with N at 50+ P at 20 Kg ha^{-1} in summer season and with N at 25 + P at 40 Kg ha^{-1} in winter season.

Lingaiah *et al.* (1988) stated that the highest yield of bitter gourd was obtained in coastal region at N: P_2O_5: K_2O at 80:30:20 kg ha^{-1}.

Vishnu *et al.* (1987) studied the effect of plant spacing and fertilizers on yield of bottle gourd. It was reported that the average yield was 38537 kg ha^{-1} with the full dose of NPK (180:100:100 kg ha^{-1}) and 30074 kg ha^{-1} with the reduced dose (one third of the full dose).

Seshadri (1986) concluded that all gourds respond well to manures and fertilizer application. The doses of fertilizers depend upon the soil type, climate and system of cultivation. In cucurbits, excessive nitrogen and consequently enormous vine growth require to be avoided. In general, high N under high temperature conditions promote maleness in flowering and number of female perfect flowers per vine gets reduced resulting in low fruit set and low yield.

Pelaez *et al.* (1984) studied the effect of NPK and organic matter on yield and marketable fruits of squash (*Cucurbita pepo* L.). According to their investigations plots receiving 10 t/ha poultry manure gave the highest followed by plots receiving 100 kg N, 300 kg P_2O_5 and 75 kg K_2O per hectare, which yielded 21.24 t ha^{-1} and 3.2 fruits $plant^{-1}$.

Ogunremi (1978) reported that the fruit size and numbers were the highest when applied with N at 48 kg ha^{-1} in melon.

Makal *et al.* (1977) studied the effect of NPK on yield of tinda. It was reported that N, P_2O_5 and K_2O at the rate of 75, 50 and 100 kg ha^{-1} enhanced the yield from 3207.7 kg ha^{-1} to 3697.7 kg ha^{-1}.

Catedral (1974) found that ampalaya (bitter gourd) is very responsive to nitrogen fertilization applied as high as 480 kg ha^{-1}. The most significant effect was on the significant increase in the number of pistillate flowers. In that study, the increase was as high as 6 times when the rate of the level of N was increased from 0 to 480 kg ha^{-1}.

It was also shown that fruit number per plant increased with increasing levels of N, whereas phosphorus had no effect.

Pandey and Singh (1973) found that soil application of up to 100 kg N ha^{-1} increased the number of pistillate and staminate flower and the yield; the sex ratio was not affected in bottle gourd. Maleic hydrazide approximately doubled the proportion of female flowers and also increased yield. Combined application of N and maleic hydrazide gave a further increased in the proportion of female flowers and the highest yield.

Fuchs *et al.* (1970) reported that nutrients from mineral fertilizers enhance the establishment of crops while those from mineralization of organic manures promoted yield when both fertilizers were combined.

Lingle and Wight (1964) obtained the yield increases of 20 to 30 percent after application of nitrogen in cantaloupes.

Matzusaki and Hayase (1963) reported that when all the nitrogen was applied before planting, early vegetative growth was retarded by higher levels in cucumber. They also said that the number of flowers was not affected by different levels but the higher N level increased fruit set and length of ovary at flowering time.

Jamir *et al.* (2022) carried out an investigation entitled "Effect of organic and inorganic fertilizer on growth, yield & quality of cucumber (*Cucumis Sativus* L.) Under protected cultivation" was carried out in the Polyhouse of Jacob Institute of Biotechnology and Bioengineering, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, during winter season from September to December 2021. The study revealed that the treatment T_{10} (Recommended Dose of Fertilizer (RDF) 50% + Poultry manure 50%) performed best in terms of no. of leaves (107.62 $plant^{-1}$),days to first flowering(36.94), days to harvest (62.33), fruit length (15.03 cm), fruit diameters (14.1 mm),number of fruits $plant^{-1}$ (20.70),weight (162.40 g), yield $plot^{-1}$ (3.26 Kg), yield per 200 sq.m (571.52 Kg) and Vitamin C (7.57 mg/100 g fresh fruit). However, treatment T_7 (25% RDF + 75% FYM) has maximum number days to fruit set (57.36) and treatment T_4 (RDF 50% + FYM 50%) had highest soluble solid (3.77^{o}Brix). The significantly higher gross return (Rs 17,145.6/ha), Net Profit (Rs 13,415.21/ha) and B:C ratio (3.59:1) was also recorded under treatment T_{10} ((RDF) 50% + Poultry manure 50%). Overall

results revealed that T_{10} (RDF) 50% + Poultry manure 50%) was found to be the most suitable over all the other treatments in relation to growth and yield of Cucumber.

Kaur and Rattan (2021) conducted an investigation during 2019 at DAV University, Jalandhar, to find out the effect of organic manures and chemical fertilizers on the growth and yield of summer squash (*Cucurbita pepo* L.) *cv.* Punjab Chappan Kaddu. The experiment consisted of eleven treatments and three replications. Out of these, an application of 25% of the recommended dose of chemical fertilizer + vermicompost 15 t/ha (T_8) had a beneficial effect on minimum days to the first female flower (74.67 days), minimum days to the first fruit set (76.33), minimum days to the first fruit harvest (78.33). The maximum plant height (122.85cm) was recorded in 25% of the recommended dose of chemical fertilizer + FYM 25 t/ha (T_5). 75% of the recommended dose of chemical fertilizer + EM (Effective Micro-organism) Bokashi 2.5 q/ha (T_9) resulted in minimum days to male flower appearance. The maximum sex ratio (0.38), was obtained with the application of 50% of the recommended dose of chemical fertilizer + EM Bokashi 3 q/ha (T_{10}). The maximum number of pickings (26) and number of fruit per plant (9.85) were obtained with the application of 50% of the recommended dose of chemical fertilizer + EM Bokashi 3 q/ha (T_{10}). The maximum fruit yield per plant (2.20 kg), fruit yield per plot (26.26 kg), fruit yield per ha (405.57 q) were recorded with the application of 50% of the recommended dose of chemical fertilizer + vermicompost 15 t/ha (T_7). The maximum Total Soluble Solids (TSS) (2.40B°) were recorded with the application of 75% of the recommended dose of chemical fertilizer + FYM 20 t/ha (T_3) while, the ascorbic acid was maximum (52.50 mg/100g) when 25% of the recommended dose of chemical fertilizer + vermicompost 15 t/ha (T_8) were applied. The highest net returns and benefit: cost (4.5) were obtained when 50% of recommended dose of chemical fertilizer + FYM 25 t/ha (T_4) was applied.

Singh *et al.* (2021) carried out an experiment during September to November, 2020 in Research Field of Department of Horticulture, SHUATS, Prayagraj to find out the effect of organic and inorganic fertilizer on growth, yield and quality traits of cucumber (Cucumis sativus) . The experiment was conducted in Randomized Block Design (RBD), with nine treatments, replicated thrice of organic and inorganic fertilizers. the treatments were T_0 (Control (Recommended dose of NPK 100:80:100 kg/ha), T_1 (Neem Cake 75% + NPK 25%), T_2 (Neem Cake 50% + NPK 50%), T_3

(Vermicompost 75% + NPK 25%), T_4 (Vermicompost 50% + NPK 50%), T_5 (Sheep Manure 75% + NPK 25%), T_6 (Sheep Manure 50% + NPK 50%), T_7 (Vermicompost 50% + Sheep Manure 25% + NPK 25%) and T_8 (Vermicompost 25% + Sheep Manure 25% + Neem Cake 25% + NPK 25%). From the present experimental findings it is found that the treatment T_8 (Vermicompost (25%) + Sheep Manure (25%) + Neem Cake (25%) + NPK (25%)) was found superior over other treatments in terms of growth, yield and Quality of Cucumber, followed by treatment T_7 (Vermicompost (50%) +Sheep Manure (25%) + NPK (25%)), in terms of economics maximum Gross return, Net Return and Cost Benefit ratio was also recorded in treatment T_8 and lowest readings was recorded in T_3 (Vermicompost (75%) + NPK (25%)).

Mahale *et al.* (2018) carried out a field experiment entitled "Effect of Integrated Nutrient Management on Snake gourd (*Trichosanthes anguina* L.) In Lateritic Soils of Konkan" laid out in Randomized Block Design comprising eleven treatment combinations replicated thrice, at Vegetable Improvement Scheme, Central Experiment Station, Wakawali, Dr. B.S.K.K.V., Dapoli, Dist. Ratnagiri during the kharif season of 2016. The effect of integrated nutrient management including vermicompost and poultry manure either alone or in combinations with inorganic fertilizers on fruit yield, and nutrient content of snake gourd were studied. The application of 50% N through poultry manure + 50% N through inorganic fertilizers T_6 significantly influenced the growth parameters, fruit yield and total nutrient status viz. N, P, K, Ca, Mg, and S. The build-up of fruit quality, the application of 50% N through poultry manure + 50% N through inorganic fertilizer was found to be suitable for snake gourd in lateritic soil of Konkan.

Singh *et al.* (2017) conducted a field experiment at Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, (U.P) India, during the rabi season of 2016-17, to study the effect of different organic and inorganic fertilizers on cucumber yield under protected cultivation. The experiment was laid out in randomized block design with three replications consisted of nine treatment combinations viz. T_0 (Control), T_1 [FYM (75%) + NPK (25%)], T_2 [FYM (50%) + NPK (50%)], T_3 [Vermicompost (75%) + NPK (25%)], T_4 [Vermicompost (50%) + NPK (50%)], T_5 [Poultry manure (75%) + NPK (25%)], T_6 [Poultry manure (50%) + NPK (50%)], T_7 [FYM (50%) + Poultry manure (25%) + Vermicompost

(25%)] and T_8 [FYM (25%) + Poultry manure (25%) + Vermicompost (25%) + NPK (25%)] were allocated randomly in each plot. The results showed that the treatment T_8 (FYM (25%) + Poultry manure (25%) + Vermicompost (25%) + NPK (25%) significantly found best among the all treatments at all successive growth stages in term of maximum plant height (370.00 cm), Number of leaves (119.84) and Number of Branches per plant (3.51) as growth parameters whereas maximum length of fruit (15.03 cm), fruit diameter (14.07 cm), average fruit weight (198.93 g), fruit yield per plot (11.87 kg) and fruit yield per hectare (824.30 q/ha) as yield related traits and also recorded maximum with TSS (4.10^0 Brix) and vitamin C (8.39 mg/100g of fruit pulp) with lowest acidity (0.90 %) as quality parameters while lowest response in term of growth, yield and quality of cucumber was recorded with T_0 (control) which received only recommended dose of NPK (120:60:120 kg per hectare).

Pokhrel *et al.* (2015) conducted an experiment where four combinations of two solid organic fertilizers (Monterra Malt and chicken manure) were applied before planting strawberry and two liquid organic fertilizers (broad bean and Pioner Hi-Fruit/K-Max) specified through drip irrigation (fertigation) and was compared with inorganic fertilization regarding growth, yield, nutrient concentration, and fruit quality of strawberries. Broad bean fertigation combined with Monterra Malt resulted in a alike fruit yield as inorganic fertilizer and a higher yield than Monterra Malt combined with Pioner; however, total soluble solids, firmness, and titratable acid were improved with Pioner fertigation, although these parameters were more affected by harvest time than the applied fertilizers. The concentrations of most nutrients in fruits and leaves were greater in inorganically fertigated plants. The reductions in fruit yield in three of four treatments and fruit weight in all organic treatments may be due to a combination of the following conditions in the root zone: (1) high pH and high NH4 +/NO3 – ratio; (2) high EC and/or high NaCl concentration; (3) cation disparity; and (4) nutrient deficiency.

Embiowei and Emiri (2015) evaluated organic manure (OM) and inorganic fertilizer (NPK) on the yield and yield components of cucumber under different irrigation regimes and cropping seasons at Isampou, Bayelsa State, Nigeria. 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 PM 5 t + ha^{-1} + NPK 200 kg ha^{-1}) were assigned sub-plots. Experiment results concluded that

irrigation rates did not seem to have significant relative effect on growth and yield of cucumber across the cropping periods. Cucumber vines generally were longest in OM treated plots in all water levels. In the second planting OM treated plots at 20,000; 25,000 and 30,000l ha^{-1} day produced the longest vines. But NPK + OM had the longest vine for the second and third plantings. NPK + OM amended plots consistently produced the highest cucumber fruit yield at 25,000 and 30,000 l ha^{-1} water levels (5.59 and 5.74 t ha^{-1}) during the first cropping period. While control plots consistently produced the lowest cucumber fruit yield for the first, second and third cropping period respectively (3.81, 4.41 and 3.98 t ha^{-1}).

Natsheh and Mousa (2014) carried out a greenhouse experiment in Tulkarm, Palestine, during the summer season of 2012 to evaluate the effect of compost on cucumber (*Cucumis sativum* L.) productivity and soil properties. The results showed that the application of compost improving the soil characteristics; increasing soil productivity and organic matter content. Compost application can compensate use of chemical fertilizers, which have adverse environmental effects. The experimental results confirmed that the use of organic fertilizers increasing the crop productivity with compost (7005 kg/dunum, dunum is 0.1 ha) comparing with (6017 kg/dunum) with chemical fertilizers, on the other hand, increasing the soil fertility and saving water, were the water requirements was decreasing with using compost (180 m^3/season) comparing with (213 m^3/season) were chemical fertilizers used during the agriculture period.

Reddy and Rao (2004) was conducted Farm experiment in Hyderabad, Andhra Pradesh , India with bitter gourd (*M. charantia*) consisting of 4 vermicompost levels (0, 10, 20 and 30 t ha^{-1}) and 3 N levels (20, 40 and 80 kg ha^{-1}). The vine length, number of branches, number of fruits per vine and fruit yield ha^{-1} have been significantly increased by the application of vermicompost and N. Delayed flowering was observed with higher levels of N and Vermicompost.

Rekha and Gopalakrishnan (2001) conducted a field experiment with bitter gourd (*Momordica charantia* L.) *cv.* Preethi in Thrissur, Kerala, India during kharif 1999. Considering the total yield, marketable yield and size of fruits, the treatment T7 which received a basal application of 20 tons of dry Cowdung, 2.5 tons of poultry manure, fortnightly drenching of 2.5 tons of cowdung and a fertilizer dose of 70:25:25 kg NPK

ha^{-1} was found superior to all other treatments. More or less equal fruit yield and fruit size were also recorded in T_5, which received same manures but lacked inorganic fertilizers. This was clearly revealed the possibility of achieving a reasonably good yield by basal application of dry cowdung, top dressing with poultry manure and by drenching cowdung slurry at fortnightly interval.

Isaac and Pushpakumari (1997) conducted a field trial at Department of Agronomy, College of Agriculture, Vellayani, India in 1994-95, where okras were grown with 6 t/ha FYM + chemical fertilizers and 12 t ha^{-1} FYM + chemical fertilizers or vermicompost or poultry manure. The effect of picking no, 2, 4 or 6 green fruits $plant^{-1}$ was also examined. Fruit and seed yields were highest with FYM + chemical fertilizers, but there was only a marginal benefit in applying the higher rate of FYM. Seed yield declined as more fruits were picked.

Murwira and Kirchman (1993) observed that nutrient use efficiency might be increased through the combination of manure and inorganic fertilizer. This study was therefore conducted to investigate the effects of varying rates of farmyard manure and inorganic fertilizers on the growth and yield of cucumber.

Costa et *al.* (1991) observed that addition of manure increases the soil water holding capacity and this means that nutrients would be made more available to crops where manures have been added to the soil.

Subbaiah *et al.* (1985) conducted a trial with tomato and bitter gourd to evaluate the effect of FYM and micronutrients lower than soil fertility status. The author determined that the main object for extended mean fruit weight and fruit yield by the application of FYM with NPK and vermicompost was attributed to solubilization effect of plant nutrients by the addition of vermicompost and FYM leading to highly uptake of NPK.

Titiloye (1982) reported that the most satisfactory method of increasing maize yield was by judicious combination of organic wastes and inorganic fertilizers.

Satish *et al.* (1988) stated that in 2 season trials, N at 0, 25, 50 and 75 kg ha^{-1} and P at 0, 20, and 40 kg ha^{-1} were applied to the *cv.* Pusa Chikni. Half of the N dose and all P were applied before sowing on 9 March and 9 July and the remaining N was used for top dressing in 2 equal doses at 25 and 50 days after sowing. In both seasons, 50 kg N+20 kg P ha^{-1} gave the maximum number of fruits and the greatest weight $plant^{-1}$ in

the early and total yields. Maximum fruit dry matter content was obtained by applying 25 kg N + 40 kg P ha^{-1} in the summer season crop and 40 kg P ha^{-1} in the rainy season (July).

A large beneficial microbial population and biologically active metabolites, specific gibberellins, cytokinins, auxins and B vitamins were experimental with application of vermicompost alone or in combination with organic or chemical fertilizers, so as to get better yield and quality of diverse crops (Bano and Kale, 1987).

From the above review of literature it was revealed that different organic matters and fertilizer management practices significantly affect the growth and yield of snake gourd. The treatments of the present work justify the single and combined effect of organic and inorganic fertilizer management to identify most suitable treatment for snake gourd production.

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted during the period from March 2020 to July 2020 to investigate the effect of nutrient combination of the growth and yield of snake gourd (*Trichosanthes anguina* L.). This chapter includes a brief explanation of the experimental period, location, soil and climate condition of the experimental area and materials that were used for conducting the experiment i.e. treatment and design of the experiment, growing of crops, intercultural operations, data collection procedure and procedure of data analysis that were used for conducting the experiment.

3.1 Experimental Site

The research was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh (Appendix I). The experiment was carried out during rabi season. The location of the experimental site is situated at 90° 22' E longitude and 23° 41' N latitude. The altitude of 8.6 meters above the sea level.

3.2 Characteristics of soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) under AEZ No. 28. The selected plot was medium high land and the soil series was Tejgaon (FAO, 1988). The characteristics of the soil under the experimental plot were analyzed in the Soil Testing Laboratory, SRDI Farmgate, Dhaka and the results showed that the soil composed of 27% sand, 43% silt and 30% clay. The soil was having a texture of sandy loam with pH and organic matter 5.47 – 5.63 and 0.83%, respectively. The details soil characteristics are presented in Appendix II.

3.3 Climatic condition of the experimental site

The experimental area was under the subtropical climate, characterized by three distinct seasons, winter season from November to February and the pre-monsoon or hot season from 12 March to April and the monsoon period from May to October (Edris *et al.* 1979). During the experimental period the maximum temperature (34.56^0 C), highest relative humidity (74.82 %) and highest rainfall (68.5 mm), highest rainfall (82.97 mm) was recorded in the month of April 2020, whereas the minimum temperature (21.76^0 c), minimum relative humidity (62.04%) and no rainfall was

recorded for the month of march, 2020 (Appendix III). The climatic condition during the period of experiment was collected from the Bangladesh Meteorological Department, Agargaon, Dhaka.

3.4. Agro-ecological region

The experimental field belongs to the agro-ecological region of the Madhupur Tract (AEZ 28). The area was under the sub-tropical monsoon climate, which is characterized by heavy rainfall during Kharif season (April to August) and scanty of rainfall during the rest of the year. The landscape comprises level upland, closely or broadly dissected terraces associated with either shallow or broad, deep valleys.

3.5. Experimental details

3.5.1 Planting materials used in the experiment

The test crop used in the experiment was snake gourd which is a local variety and seeds were collected from Kishoreganj.

3.5.2 Experimental treatments:

A total of 11 treatments are stated below

1. T_0: control (No organic and inorganic fertilizer)
2. T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1})
3. T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF)
4. T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF)
5. T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}
6. T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}
7. T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1}+ B_2 kg ha^{-1}
8. T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1}+ Zn_6 kg ha^{-1} + B_2 kg ha^{-1}
9. T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1}+ Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}
10. T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1}+ Mg_7 kg ha^{-1} + B_2 kg ha^{-1}
11. T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}

*CD=Cow-dung

*PM=Poultry Manure

*V=Vermicompost

3.5.3 Design and layout of the experiment

The factor of the experiment was laid out in a Completely Randomized Design (CBD) with three replications where the experimental area was divided into two equal blocks representing the replications to minimize the soil heterogeneous effects .The length of the experimental area 22.6 m and width 5 m and the total area of the experimental plot was 112.5 m^2. The total area is divided into two equal blocks. Each block was divided into 11 plots where 11 treatments combination were allotted at random. There were total 22 unit plots in the experiment. The size of the each plot was 1.5 m × 1.5 m. The distance maintained between two blocks and two plots were 1 m and 0.5 m, respectively. Side drainage spacing was 0.5m in each side respectively. The layout of experiment field is presented in (Figure. 1).

3.6 Land and pits preparation

At the last week of February the main plot was selected for conducting the experiment was opened with a power tiller, and left exposed to the sun for a week. Then the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain good puddle condition. The weeds and different kind of stubbles were removed to make it clean. In accordance to the experimental design the experimental area was partitioned into different unit plots. Different organic and inorganic fertilizers were mixed with soil. Pits of 50 x 50 x 45 cm sized were prepared.

3.7. Seed treatment

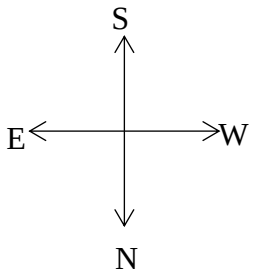
For rapid and uniform germination, the seeds of Snake gourd were soaked for 12 hours in water before sowing. Seeds were treated with Vitavex @ 2 g kg^{-1} seeds before sowing to avoid seed borne diseases and get vigorous seedlings.

3.8 Seed sowing

Seeds were sown in the field 11th march 2020. 4 seeds were sown in every pit. Seeds were sown at a depth of 2 cm. There were 2 pits in every plot. Seedlings were not attacked by any kind of insect or disease.

Layout of the experiment:

Total no. of unit plots: 33
Total no. of treatments: 11
Plot size: 1.5 m × 1.5 m
Plot to plot distance: 0.5 m
Block to block distance: 1m



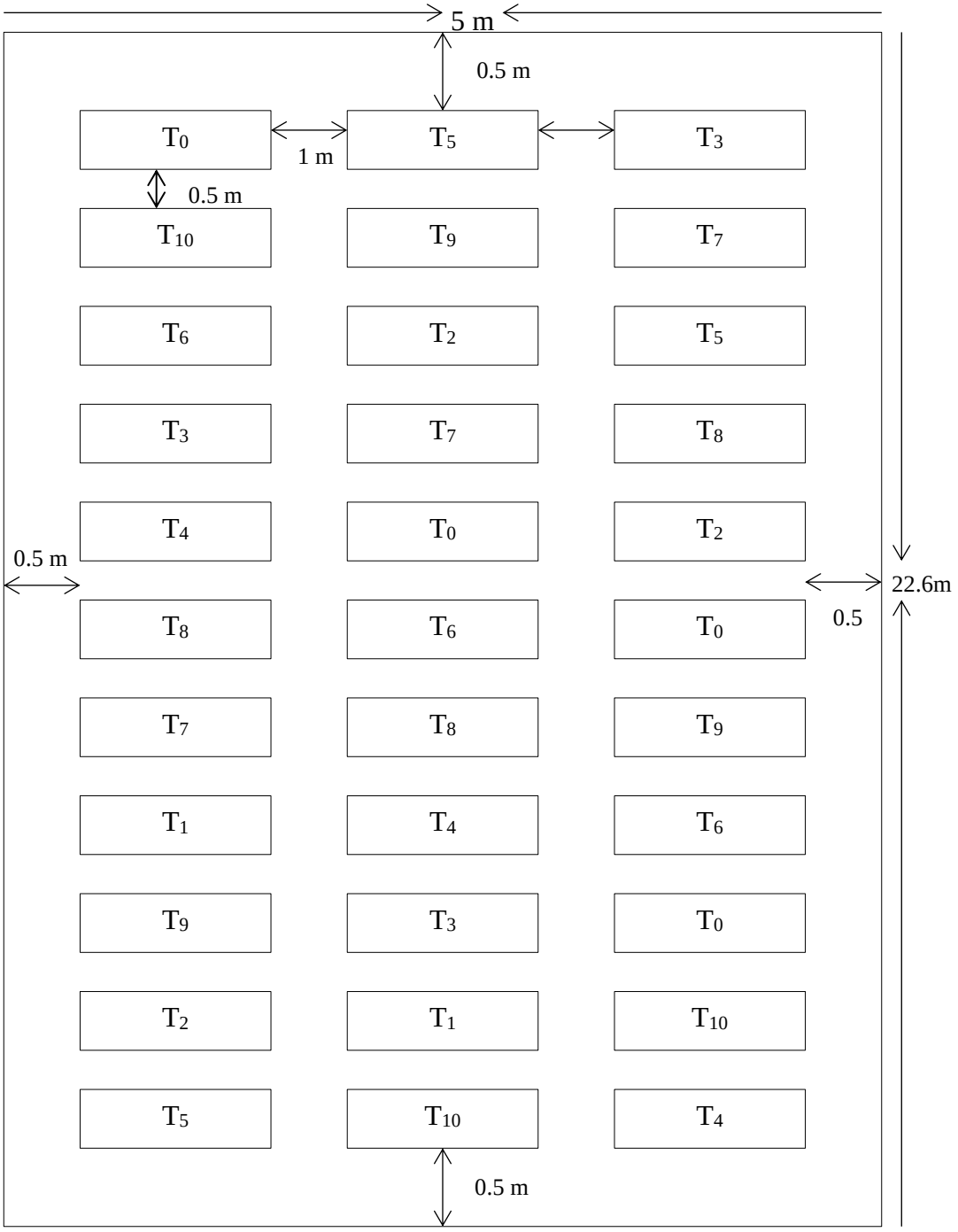


Figure 1. Field layout of the experiment in the Randomized Complete Block Design (RCBD)

3.9 Inorganic and organic fertilizer application

The inorganic and organic fertilizer for snake gourd was applied at the recommended doses. The recommended dose for snake gourd production comprising cowdung 10t ha^{-1}, Urea 175kg ha^{-1}, TSP 175kg ha^{-1}, MoP 150kg ha^{-1}, Zypsum 100kg ha^{-1}, Zinc oxide 12.5kg ha^{-1}, Borax 10kg ha^{-1}, Magnesium oxide 12.5kg ha^{-1} (BARI, 2011). Full doses of cow-dung, poultry manure and vermin-compost was applied during final land preparation. The full doses of MoP, Zypsum, Zinc Oxide, Magnesium Oxide and Borax were applied during land preparation. TSP was given into 3 spilit doses half of the TSP was given as first dose during land preparation and remaining half was further divided and first divided portion was given before 7-10 days of seed sowing second after 15 days of germination. The dose of the entire amount of Urea was divided into 4 parts. First dose given after 15 days of germination, second dose given after 30-35 days of germination, Third dose at the flowering stage (50-55 days after germination) and the fourth and last dose was given after 70-75 days during the harvesting stage.

3.10 Intercultural operations

Various intercultural operations, such as gap filling, weeding, mulching with water hyacinth, earthing up, irrigation pest and disease control etc. were accomplished for better growth and development of the snake gourd seedlings. The crop was kept free from weeds by regular weeding and irrigated as and when required.

3.10.1 Gap filling

The experimental plot was taken under careful observation. Very few seedlings were damaged after sowing. The damaged seedlings were replaced by new healthy seedlings. The seedlings were taken from the same stock. The seedlings were transplanted with big mass of soil to avoid any damages. The newly transplanted seedlings were under special care for their proper establishment.

3.10.2 Weeding

Weeding was done at 15, 30, 45 and 60 days after transplanting to ensure the plot free from weeds.

3.10.3 Mulching

For the retention of water the water hyacinth was given at the base of plants. It helps to conserve the water from evaporation.

3.10.4 Irrigation and drainage

Earlier on the seedling establishment stages light watering was given by a watering cane at every afternoon. After well establishment of the seedlings watering was given with irrigation channels. At the reproductive stage no water stress was encountered. Proper drainage facilities were made surrounding the experimental plots for drainage of excess water.

3.10.5 Vine management

For proper growth and development of the plants the vines were managed by hand to spread them over the net of trellis.

3.10.6 Trellis

Four bamboo poles were set keeping 5 feet high from the ground level in every plot. These poles were connected to one another by bamboo. Bamboo, plastic rope and jute rope was used to make the trellis. A bamboo stick is placed near the seedling. Thus a trellis for each plot was made for creeping the vines of crop.

3.10.7 Pest control

During the period of establishment of seedling in the field insect infestation was a serious problem. Cut worm attacked at the seedling stages, it was controlled both mechanically and spraying Darsban 29 EC @ 3%. Some plants were infested with Aphid, to control them Tafgar @ 2.5 ml L^{-1} was applied. Along with these some plants were infected with powdery mildew to control it S-dust (sulcox) was sprayed @ 5gm L^{-1}. At the reproductive stage fruit fly was seen to harm the fruit, to control them pheromone trap was set up 1trap per 10m. At different times diseased leaves were removed from the field.

3.11 Harvesting

Harvesting was done by hand picking. Fruits are harvested at tender stage and before 100 % maturity. They were harvested when the fruits contain hair on their skin.

Young fruits are hairy and usually light green in color. Harvesting of fruits was started at and continued up to final harvest based on the marketable size of fruits.

3.12 Data collection

The data were recorded on following parameters from the studied plants during the experiment.

3.12.1. Vine length at vegetative stage (cm)

The vine length was recorded 30 days after sowing (DAS). Data were recorded as average of all plants of each plot in sq. meter (m^2). The height of every plant was measured from the ground to the tip of the stem.

3.12.2. Vine length at flowering stage (cm)

The vine length was recorded at flowering stage. Data were recorded as average of all plants of each plot in sq. meter (m^2). The height of every plant was measured from the ground to the tip of the stem.

3.12.3. Vine length at fruiting stage (cm)

The vine length was recorded fruiting stage. Data were recorded as average of all plants of each plot in sq. meter (m^2). The height of every plant was measured from the ground to the tip of the stem.

3.12.4. Number of leaves plant^{-1} at vegetative stage

The total number of leaves plant^{-1} was recorded at 30 days after sowing (DAS). Then the data were calculated as average of each plant.

3.12.5. Number of leaves plant^{-1} at flowering stage

The total number of leaves plant^{-1} was recorded at flowering stage. Then the data were calculated as average of each plant.

3.12.6. Number of leaves per plant^{-1} at fruiting stage

The total number of leaves plant^{-1} was recorded at fruiting stage. Then the data were calculated as average of each plant.

3.12.7. Leaf length (cm) at vegetative stage

The length of 5 leaves was recorded at randomly selected per plant at the vegetative stage 30 days after sowing (DAS).

3.12.8. Leaf length (cm) at flowering stage

The length of 5 leaves was recorded at randomly selected per plant at the flowering stage.

3.12.9. Leaf length (cm) at fruiting stage

The length of 5 leaves was recorded at randomly selected per plant at the fruiting stage.

3.12.10. Leaf breadth (cm) at vegetative stage

For the measurement of leaf breadth 5 leaves per plant selected at randomly. The leaf breadth was measured in cm (centimeter) and average value was calculated for each plant at 30 days after sowing.

3.12.11. Leaf breadth (cm) at flowering stage

For the measurement of leaf breadth 5 leaves per plant selected at randomly. The leaf breadth was measured in cm (centimeter) and average value was calculated for each plant at flowering stage.

3.12.12. Leaf breadth (cm) at fruiting stage

For the measurement of leaf breadth 5 leaves per plant selected at randomly. The leaf breadth was measured in cm (centimeter) and average value was calculated for each plot at fruiting stage.

3.12.13. Number of primary branches plant^{-1} at fruiting stage

The total number of branches plant^{-1} was recorded from each plant of snake gourd. The data were recorded of all plants of each plot at fruiting stage and average was calculated for each plot.

3.12.14. Days required to 1st male flowering

The number of days required between the date of sowing to the date of 1st male flower emergence of a plant was recorded and average was calculated.

3.12.15. Days required to 1st female flowering

The number of days required between the date of sowing to the date of 1st female flower emergence of a plant was recorded and average was calculated.

3.12.16. Number of male flowers plant^{-1}

The total number of male flowers plant^{-1} was counted from each plot after flowering and mean value was calculated.

3.12.17. Number of female flowers plant^{-1}

The total number of female flowers plant^{-1} was counted from each plot after flowering and mean value was calculated.

3.12.18. Days to 1st fruit set

This data was recorded the days required to first fruit setting in every plot. It was measured as the days taken from sowing to first fruit setting.

3.12.19. Days to 1st fruit harvest

This data was recorded during the first harvest of fruit from every plant and plot. It was measured as the days taken from sowing to first harvesting.

3.12.20. Fruit length (cm)

Length of each fruit was recorded during the harvesting from individual plant and average fruit length was calculated. Fruit length was calculated in centimeter (cm).

3.12.21. Fruit diameter (cm)

During harvesting diameter of each fruit was recorded from individual plant and average fruit diameter was calculated. Fruit diameter was calculated in centimeter (cm).

3.12.22. Number of fruits plant^{-1}

The total number of fruits plant^{-1} was counted after setting of fruits and average was calculated.

3.12.23. Individual fruit weight (kg)

The weight of individual fruit was recorded after each harvest and expressed in kilogram (kg) and mean value was calculated.

3.12.24. Fruit yield plant^{-1} (kg)

The fruit weight of all the fruits harvested from a plant was recorded and the sum of all fruit of a plant was calculated. The fruit weight was expressed in kilogram (kg).

3.12.25. Fruit yield plot^{-1} (kg)

The fruit weight of all the fruits harvested from a plot was recorded and the sum of the weight all fruits of a plot was calculated. The fruit yield was expressed in kilogram (kg).

3.12.26. Fruit yield hectare^{-1} (t)

Yield hectare^{-1} of snake gourd was calculated by converting the plot^{-1} yield into hectare and was expressed in ton.

3.13 Statistical analysis

The recorded data on different parameters were statistically analyzed using Statistic 10 software. The significance of the difference among the treatments means was estimated by least significant difference test (LSD) at 5% level of probability.

3.14 Economic analysis

The cost of production was calculated to find out the most economic combination of concentration of fertilizers and organic matter. All input cost like the cost for land lease and interests on running capital were computing in the calculation. The interests were calculated @ 13% in simple rate. The market price of snake gourd was considered for estimating the return. Analyses were done according to the procedure of Alam *et al. (1989).*

3.14.1. Analysis for total cost of production of snake gourd

All the material and non-material input cost, interest on fixed capital of land and miscellaneous cost were considered for calculating the total cost of production. Total cost of production (input cost, overhead cost), gross return, net return and BCR are presented in Appendix.

3.14.2. Gross income

Gross income was calculated on the basis of sale of branch and fruit. The price of fruit was assumed to be Tk. 42 kg^{-1} on the current market value of Kawran Bazar, Dhaka at the time of harvesting.

3.14.3. Net return

Net return was calculated by deducting the total production cost from gross income for each treatment combination.

Net return = Gross return per hectare (Tk.) - Total cost of production per hectare (Tk.)

3.14.4. Benefit cost ratio (BCR)

The benefit cost ratio (BCR) was calculated as follows:

Benefit cost ratio (BCR) = Gross return per hectare (Tk.) /Total cost of production per hectare (Tk.).

CHAPTER IV

RESULTS AND DISCUSSION

The present experiment was conducted to determine the effect of plant growth regulators and fertilizer management practices on flowering, growth and yield of snake gourd (*Trichosanthes anguina* L.). Data on different growth and other parameter, yield attributes and yield were recorded. The analyses of variance (ANOVA) of the data on different components are given in Appendix III to V. The results have been presented, discussed, and possible interpretations have been given under the following headings:

4.1. Vine length (cm)

Statistically significant influence was found in terms of vine length (cm) of snake gourd at all growth stages due to the application of different levels of organic and inorganic nutrients (Table 1 and Appendix IV). At vegetative stage the maximum vine length (69.36 cm) was recorded from T_{10} treatment, which was statistically identical (65.91 cm) with T_9 treatment and the lowest vine length (42.48 cm) was recorded from T_0 (control) treatment. At flowering stage, the highest vine length (211.69 cm) was observed from T_{10} treatment, which was statistically identical (197.14 cm) with T_9 treatment and the lowest vine length (107.29 cm) was observed from T_0 (control) treatment. At fruiting stage, the maximum vine length (234.51 cm) recorded from T_{10} treatment and followed by T_9 (206.51 cm) treatment and the lowest vine length (112.43 cm) was observed from T_0. The results indicated that vine height significantly influenced by the availability of nutrients. Rajbir Singh *et al.* (2010), Mehdizadeh *et al.* (2013) and Nagavallemma *et al.* (2004) supported the findings of this experiment. Momin (2007) also supported the findings of this study and reported that different nutrient combinations increase plant height of bitter gourd. Mahale *et al.* (2018) reported that the application of 50% N through poultry manure + 50% N through inorganic fertilizers significantly influenced the growth parameters, fruit yield and total nutrient status *viz.* N, P, K, Ca, Mg, and S in snake gourd.

Table 1.Effect of different levels of organic and inorganic fertilizers on vine length (cm) at different growth stages of snake gourd plant (*Trichosanthes anguina* L.)

Treatment	Vegetative stage(cm)	Flowering stage(cm)	Fruiting stage (cm)
T_0	42.48 g	107.29 d	112.43 e
T_1	45.25 fg	112.80 d	117.58 e
T_2	45.87 fg	135.48 c	140.73 d
T_3	50.41 ef	142.51 c	145.84 d
T_4	52.36 de	150.66 c	152.40 d
T_5	55.09 c_e	148.88 c	154.03 d
T_6	56.17 cd	149.13 c	155.55 d
T_7	60.21 bc	178.29 b	185.51 c
T_8	64.95 ab	195.63 ab	198.88 bc
T_9	65.91 a	197.14 a	206.51 b
T_{10}	**69.36 a**	**211.69 a**	**234.51 a**
$LSD_{(0.05)}$	**5.6297**	**17.753**	**18.896**
CV%	**5.98**	**6.63**	**6.77**

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.2. Number of leaves plant^{-1}

Number of leaves plant^{-1} is an important parameter of crop plant because of its physiological role in photosynthetic activities. Statistically significant influence was found in terms of number of leaves plant^{-1} of snake gourd at all growth stages for different nutrient combination (Table 2 and Appendix V). At vegetative stage the highest number of leaves plant^{-1} (56.14) was recorded from T_{10} treatment which was statistically similar with T_5 (49.10), T_8 (53.08) and T_9 (53.40 treatment and the lowest number of leaves plant^{-1} (28.23) was recorded from T_0 (control) treatment. At flowering stages, the highest number of leaves plant^{-1} (87.30) was recorded from T_{10} treatment which was statistically similar to T_9 (82.33) and T_8 (82.10) treatment and the lowest number of leaves plant^{-1} (45.78) was recorded from T_0 (control) treatment. The highest number of leaves plant^{-1} (93.24) at fruiting stage was recorded from T_{10},

which showed statistically identical results T_9 (89.87) treatment and statistically similar with T_6 (81.95), T_7 (83.31) and T_8 (86.39). The lowest number of leaves plant^{-1} (49.14) was recorded from T_0 (control) treatment at fruiting stage. The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007). This study results revealed that different nutrient availability helps to increase number of leaves per plant. Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield.

Table 2. Effect of different levels of organic and inorganic fertilizers on number of leaves plant^{-1} at different growth stages of snake gourd plant (*Trichosanthes anguina* L.)

Treatment	Vegetative Stage	Flowering Stage	Fruiting stage
T_0	28.23 g	45.78 g	49.14 g
T_1	34.58 fg	52.72 fg	56.17 fg
T_2	40.91 ef	61.60 ef	64.91 ef
T_3	42.58 de	64.86 de	70.88 de
T_4	44.56 de	65.59 de	73.83 c_e
T_5	45.28 c_e	71.93 cd	77.67 b_d
T_6	49.10 a_d	72.44 b_d	81.95 a_d
T_7	48.09 b_e	76.77 bc	83.31 a_c
T_8	53.08 a_c	82.10 a_c	86.39 ab
T_9	53.40 ab	82.33 ab	89.87 a
T_{10}	**56.14 a**	**87.30 a**	**93.24 a**
$LSD_{(0.05)}$	**7.8564**	**10.247**	**11.554**
CV%	**10.23**	**8.67**	**9.02**

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.3. Leaf length at vegetative stage (cm)

Different treatments showed statistically significant variation for leaf length of snake gourd at vegetative stage (Table 3 and Appendix VI). At vegetative stage, the highest

leaf length (9.63 cm) recorded from T_{10} treatment. On the other hand, the lowest leaf length (7.94 cm) was recorded from T_0 (control) treatment. Rajbir Singh *et al.* (2010), Mehdizadeh *et al.* (2013) and Nagavallemma *et al.* (2004) supported the findings of this experiment and reported that combined application of organic and inorganic fertilizers increases all growth and yield parameters of cucurbits.

Table 3. Effect of different levels of organic and inorganic fertilizers on leaf length at vegetative stage (cm) and no. of branches at flowering stage of snake gourd plant (*Trichosanthes anguina* L.)

Treatments	Leaf length at vegetative stage	No. of branches at flowering stage
T_0	7.9433 c	4.95 g
T_1	8.4767 bc	5.35 g
T_2	9.4667 a	7.25 cd
T_3	9.1333 ab	6.59 de
T_4	9.2667 a	5.51 fg
T_5	9.0000 ab	6.22 ef
T_6	9.3000 a	7.37 cd
T_7	9.5667 a	7.74 c
T_8	9.4000 a	7.39 cd
T_9	9.5933 a	8.57 b
T_{10}	**9.6333 a**	**10.02 a**
$LSD_{(0.05)}$	**0.7612**	**0.7974**
CV%	**4.88**	**6.69**

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + Zn_6 + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + Mg_7 + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + Mg_7 + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + Mg_7 + Zn_6 + B_2 kg ha^{-1}.

4.4. Number of branches at flowering stage

The number of branches at flowering stage showed statistically significant difference with different levels of organic and inorganic fertilizer application (Table 3 and Appendix VI). At flowering stages the maximum number of branches (10.02) was found from T_{10} treatment followed by T_9 (8.57) treatment while minimum number of branches (4.95) was counted from T_0 (control) treatment. The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.*

(2007). Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield. Rahman, (2006) reported that combined application of cowdung and inorganic fertilizers had significant influences on time to first flower, number of male and female flower per plant, ratio of male/female flower, number of nodes with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd.

4.5. Days required to first male flowering

Different levels of organic and inorganic fertilizers application showed statistically significant influence on days required to first male flowering of snake gourd (Table 4 and Appendix VI). The maximum days required to first male flowering (60.06 days) was observed in T_0 (control) treatment whereas minimum days required to first male flowering (47.97 days) was observed in T_{10} treatment which showed statistically similar results with T_5 (53.46 days), T_6 (52.11 days), T_7 (50.94 days), T_8 (50.60 days) and T_9 (48.12 days) treatments. Rahman, (2006) supported the findings of this experiment and reported that combined application of cow-dung, poultry manure, vermicompost and inorganic macro and micro nutrients had significant influences on time to first flower, number of male and female flower per plant, ratio of male/female flower, number of node with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd.

4.6. Days required to first female flowering

The days required to first female flowering of snake gourd showed statistically significant variation for application of different levels of organic and inorganic nutrients (Table 4 and Appendix VI). The maximum days required to first female flowering (56.31 days) was recorded in T_0 (control) treatment, while the minimum days required to first female flowering (44.68 days) was observed from T_{10} treatment. The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007). Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield. Rahman, (2006) also supported the findings of this study and reported that combined application of cowdung and inorganic fertilizers had significant influences on time to first flower,

number of male and female flower per plant, ratio of male/female flower, number of nodes with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd.

Table 4. Effect of different levels of organic and inorganic fertilizers on no. of branches at flowering stage and days required for first flowering of snake gourd plant (*Trichosanthes anguina* L.)

Treatments	No. of branches at flowering stage	Days required for first flowering	
		Male	Female
T_0	4.95 g	**60.06 a**	**56.31 a**
T_1	5.35 g	58.89 ab	55.60 a
T_2	7.25 cd	57.78 a_c	55.21 a
T_3	6.59 de	56.68 a_d	55.10 a
T_4	5.51 fg	56.29 a_e	54.19 ab
T_5	6.22 ef	53.46 b_f	52.77 a_c
T_6	7.37 cd	52.11 c_f	50.72 a_c
T_7	7.74 c	50.94 d_f	49.14 a_c
T_8	7.39 cd	50.60 ef	48.61 a_c
T_9	8.57 b	48.12 f	46.12 bc
T_{10}	**10.02 a**	47.97 f	44.68 c
$LSD_{(0.05)}$	**0.7974**	**5.8273**	**8.4828**
CV%	**6.69**	**6.35**	**9.64**

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.7. Number of male flowers plant^{-1}

From the results of this experiment, it was observed that statistically significant variation was found among the different combination of organic and inorganic fertilizers in respect of number of male flowers plant^{-1} (Figure 2 and Appendix VII). The highest number of male flower plant^{-1} (79.85) recorded from T_{10} treatment, which showed statistically similar results of T_5, T_6, T_7, T_8 and T_9 treatment application whereas the lowest number of male flowers plant^{-1} (55.98) was recorded from T_0

(control) treatment. Rajbir Singh *et al.* (2010), Mehdizadeh *et al.* (2013) and Nagavallemma *et al.* (2004) supported the findings of this experiment and reported that combined application of organic and inorganic fertilizers increase all growth and yield parameters of cucurbits.

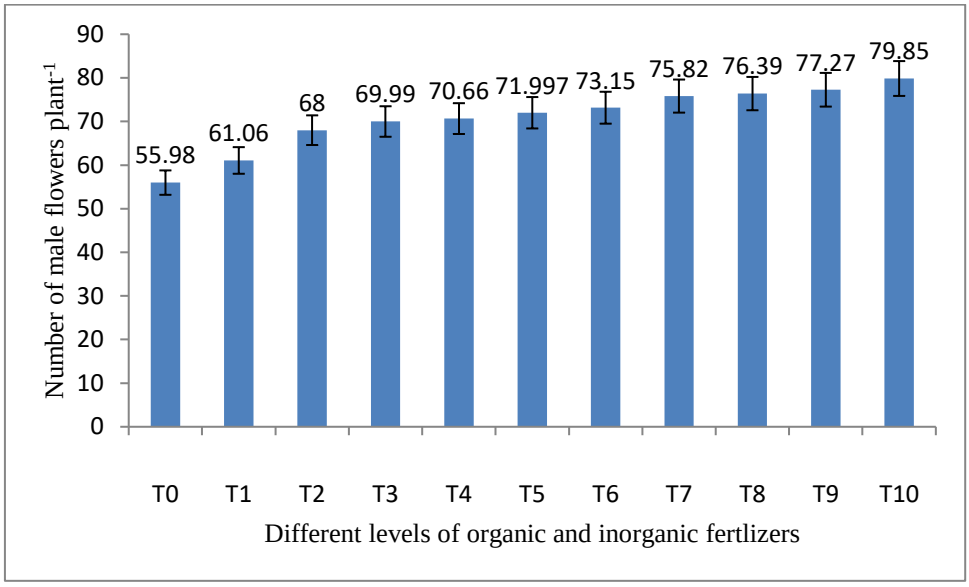


Figure 2. Effect of different levels of organic and inorganic fertilizers on number of male flowers plant^{-1} of snake gourd plant (*Trichosanthes anguina* L.).

Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.8. Number of female flowers plant^{-1}

The number of female flowers plant^{-1} of snake gourd showed statistically significant influence with different levels of organic and inorganic fertilizer application (Figure 3 and Appendix VII). Experiment results showed that the maximum number of female flower plant^{-1} (25.65) was found from treatment T_{10} which showed statistically similar results with the findings from T_7, T_8 and T_9 treatment. On the other hand minimum number of female flowers plant^{-1} (15.67) was found from T_0 (control). The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield.

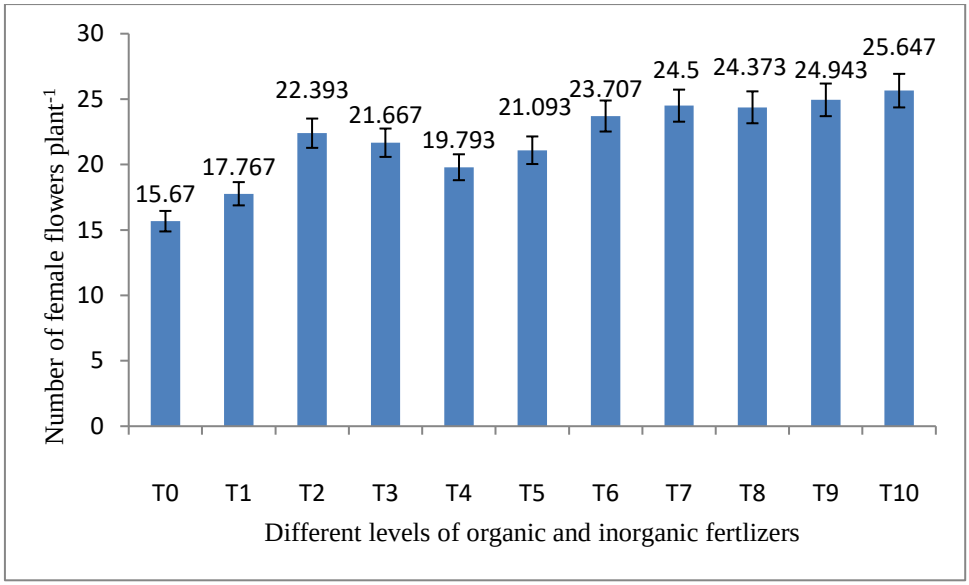


Figure 3. Effect of different levels of organic and inorganic fertilizers on number of female flowers plant^{-1} of snake gourd plant (*Trichosanthes anguina* L.).

Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.9. Days required to first fruiting

Statistically significant variation was observed on days required for first fruiting of snake gourd influenced by different levels of organic and inorganic fertilizer application (Table 5 and Appendix VII). Results indicated that maximum days required for first fruiting of snake gourd (65.77 days) was recorded from T_0 (control) treatment and the minimum days required for first fruiting of snake gourd (54.41 days) was recorded from T_{10} treatment, which showed statistically similar results with application of T_6, T_7, T_8 and T_9 treatment. Rahman, (2006) also supported the findings of this study and reported that combined application of cow dung and inorganic fertilizers had significant influences on time to first flower, number of male and female flower per plant, ratio of male/female flower, number of nodes with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd.

Table 5. Effect of different levels of organic and inorganic fertilizers on days required for first fruiting and fruit length (cm) of snake gourd plant (*Trichosanthes anguina* L.).

Treatments	Days required for first fruiting	Fruit length (cm)
T_0	65.77 a	34.74 e
T_1	64.58 ab	35.47 de
T_2	64.09 ab	36.61 c_e
T_3	63.12 a_c	37.32 c_e
T_4	61.96 a_d	38.66 b_e
T_5	60.11 b_e	38.85 b_e
T_6	58.70 c_f	40.80 a_e
T_7	56.58 ef	41.39 a_d
T_8	56.78 d_f	41.74 a_c
T_9	55.85 ef	44.14 ab
T_{10}	**54.41 f**	**45.14 a**
$LSD_{(0.05)}$	**5.22**	**6.17**
CV%	**5.09**	**9.16**

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.10. Number of fruits plant^{-1}

The number of fruits plant^{-1} of snake gourd showed statistically significant influence with different nutrient combinations (Figure 4 and Appendix VII). Experiment results showed that maximum number of fruits plant^{-1} (7.34) recorded from T_{10} treatment while minimum number of fruits plant^{-1} (3.48) counted from T_0 treatment. The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007). Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield. Rahman, (2006) also supported the findings of this study and reported that combined application of cowdung and inorganic fertilizers had significant influences on time to first flower, number of male and

female flower per plant, ratio of male/female flower, number of node with first flower, number of branches per plant, number of fruits plant^{-1}, length of fruit, diameter of fruit and yield of bitter gourd.

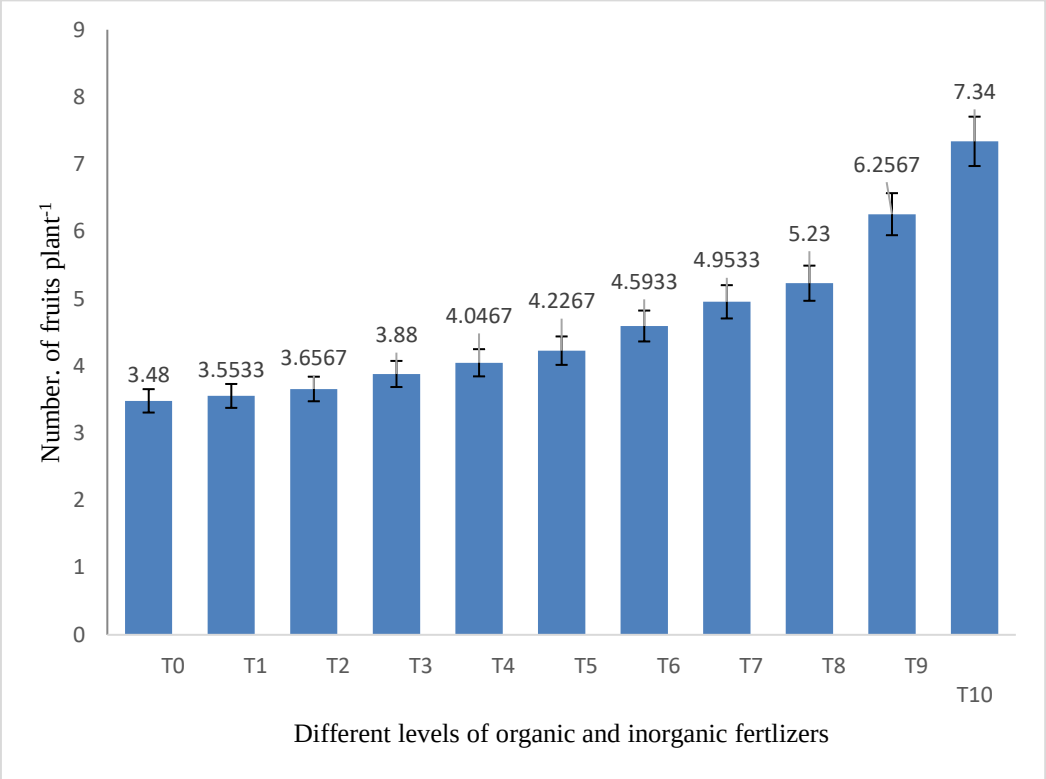


Figure 4. Effect of different levels of organic and inorganic fertilizers on number of fruits plant^{-1} of snake gourd plant (*Trichosanthes anguina* L.).

Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.11. Fruit length (cm)

Variation of snake gourd fruit length differed significantly due to different concentrations of nutrient application (Table 5 and Appendix VIII). Results signified that the highest fruit length (45.14 cm) was observed from T_{10} treatment which was statistically similar with results obtained from T_6 (40.80 cm), T_7 (41.39 cm), T_8 (41.74 cm) and T_9 (44.14 cm) treatment. Experiment results also revealed that the lowest fruit length was recorded from T_0 (34.74 cm) treatment. The result of this study was

supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield.

4.12. Fruit diameter (cm)

Statistically significant variation was noted on fruit diameter of snake gourd affected by different combinations of nutrient (Table 6 and Appendix VIII). Results revealed that the maximum fruit diameter (3.55 cm) was recorded from T_{10} treatment which showed statistically identical results with T_7 (3.48 cm), T_8 (3.49 cm) and T_9 (3.50 cm) treatment. Results also concluded that the minimum fruit diameter (2.72 cm) was observed from T_0 treatment. The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007). Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield. Rahman, (2006) reported that combined application of cowdung and inorganic fertilizers had significant influences on time to first flower, number of male and female flower per plant, ratio of male/female flower, number of nodes with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd.

4.13 Average fruit weight (g)

Average fruit weight showed statistically significant influence by different nutrient combinations (Table 6 and Appendix VIII). Experiment results concluded that the highest average fruit weight (406.47 gm) was recorded from T_{10} treatment which showed statistically identical results with T_7 (380.27 gm), T_8 (386.07 gm) and T_9 (389.85 gm) treatment. On the other hand, the lowest average fruit weight (225.96 gm) was recorded from T_0 (control) treatment. Rajbir Singh *et al.* (2010), Mehdizadeh *et al.* (2013) and Nagavallemma *et al.* (2004) supported the findings of this experiment.

Table 6. Effect of different levels of organic and inorganic fertilizers on fruit diameter (cm) and average fruit weight (g) of snake gourd plant (*Trichosanthes anguina* L.).

Treatments	Fruit diameter (cm)	Avg. fruit weight (g)
T_0	2.72 c	225.96 g
T_1	2.90 bc	268.83 f
T_2	2.88 bc	305.15 e
T_3	3.01 a_c	307.86 e
T_4	3.08 a_c	318.65 de
T_5	3.12 a_c	337.41 cd
T_6	3.38 ab	361.27 bc
T_7	3.48 a	380.27 ab
T_8	3.49 a	386.07 ab
T_9	3.50 a	389.85 ab
T_{10}	3.55 a	**406.47 a**
$LSD_{(0.05)}$	**0.57**	**29.14**
CV%	**10.44**	**5.10**

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.14. Yield plot^{-1} (kg)

Statistically significant variation was noted on yield plot^{-1} (kg) of snake gourd affected by different combinations of nutrient (Figure 5 and Appendix IX). Results revealed that the highest yield plot^{-1} (11.69 kg) was recorded from T_{10} treatment and the lowest yield plot^{-1} (3.34 kg) was recorded from T_0 treatment. Rahman, (2006) supported the results of this experiment and reported that combined application of cowdung and inorganic fertilizers had significant influences on time to first flower, number of male and female flower per plant, ratio of male/female flower, number of node with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd. Mahale *et al.* (2018) reported that the application of 50% N through poultry manure + 50% N through

inorganic fertilizers significantly influenced the growth parameters, fruit yield and total nutrient status *viz.* N, P, K, Ca, Mg, and S in snake gourd.

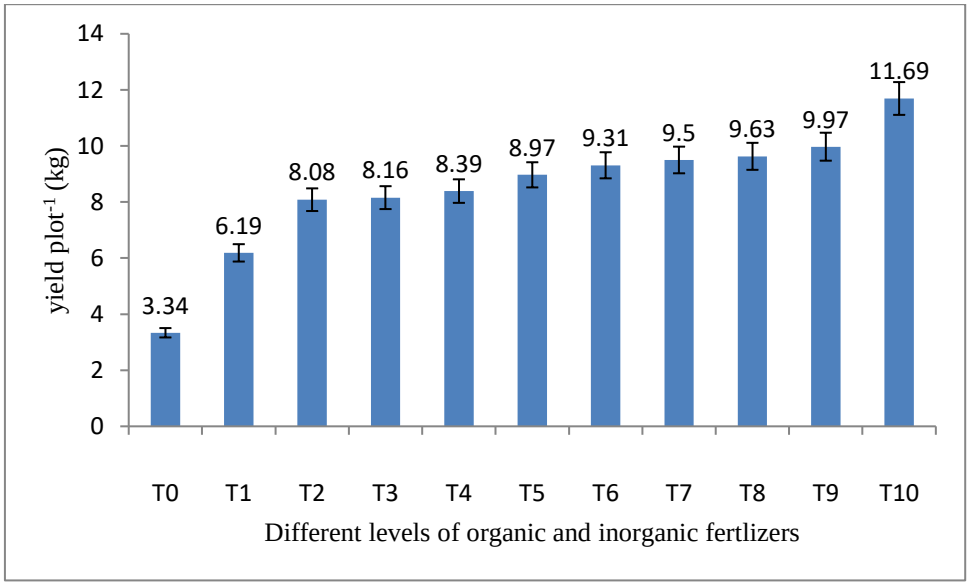


Figure 5. Effect of different levels of organic and inorganic fertilizers on Yield plot^{-1} (kg) of snake gourd plant (*Trichosanthes anguina* L.).

Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.15. Yield (t ha^{-1})

Statistically significant variation was noted on yield (t ha^{-1}) of snake gourd affected by different combinations of nutrient (Figure 6 and Appendix IX). Results revealed that the highest yield (50.10 t ha^{-1}) was recorded from T_{10} treatment and the lowest yield (14.72 t ha^{-1}) was recorded from T_0 treatment. The result of this study was supported by Ayoola and Adeniran, (2006), Kannan *et al.* (2006) and Makinde *et al.* (2007). Akter, (2017) reported that 30 ppm boron application in bitter gourd field increase plant height, branches plant^{-1}, number of female flowers plant^{-1}, number of fruits plant^{-1} and yield. Rahman, (2006) reported that combined application of cowdung and inorganic fertilizers had significant influences on time to first flower, number of male and female flower per plant, ratio of male/female flower, number of node with first flower, number of branches per plant, number of fruits per plant, length of fruit, diameter of fruit and yield of bitter gourd.

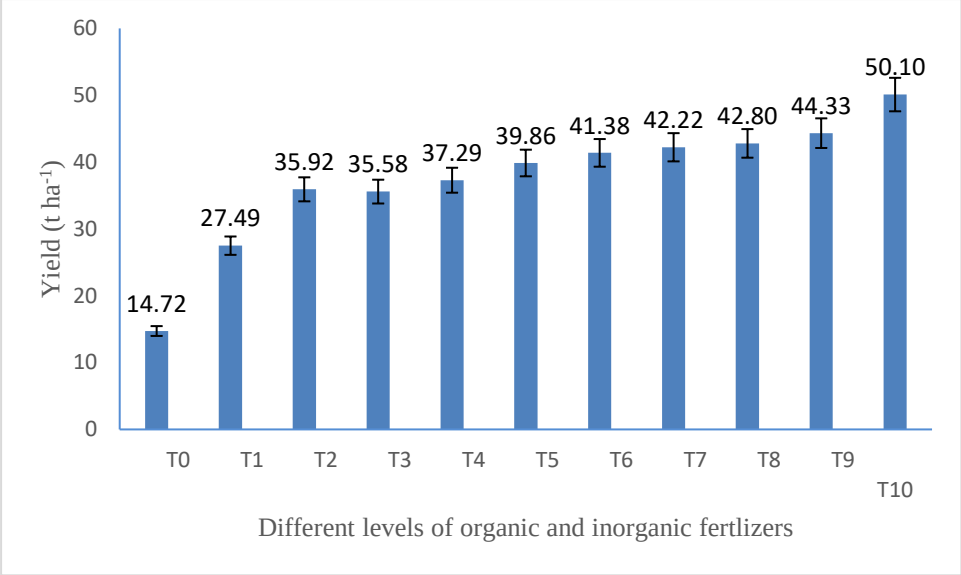


Figure 6. Effect of different levels of organic and inorganic fertilizers on Yield (t ha^{-1}) of snake gourd plant (*Trichosanthes anguina* L.).

Where T_0: control (No organic manure and inorganic fertilizer), T_1: OM ($CD_{10}PM_{10}V_5$ t ha^{-1}), T_2: $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF) T_3: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} (RDF), T_4: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1}, T_5: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1}, T_6: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ + B_2 kg ha^{-1}, T_7: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}, T_8: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1}, T_9: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + B_2 kg ha^{-1} and T_{10}: OM ($CD_5PM_5V_2$ t ha^{-1}) + $N_{80}P_{35}K_{75}S_{18}$ kg ha^{-1} + Mg_7 kg ha^{-1} + Zn_6 kg ha^{-1} + B_2 kg ha^{-1}.

4.16. Economic analysis

Input costs for land preparation, fertilizer, irrigation, equipment for making trellis and manpower required for all the operations from seed sowing to harvesting, interest on fixed capital of land (Leased land by loan basis) and miscellaneous cost were calculated for unit plot and converted into cost per hectare (Table 7). Price of snake gourd fruit was considered as per market rate. The economic analysis presented under the following headings-

4.16.1. Gross return (Tk.)

The combinations of different nutrients showed different values in terms of gross return during this study (Table 7). The highest gross return (2104200 Tk.) was found from T_{10} treatment, while the lowest gross return (618240 Tk.) recorded from T_0 treatment.

4.16.2. Net return

The combinations of different nutrients showed different values in terms of net return during this study (Table 7). The highest net return (996727 Tk.) was found from T_{10} treatment, while the lowest net return (6122 Tk.) recorded from T_0 treatment.

4.16.3. Benefit cost ratio

The combinations of different nutrients showed different values in terms of benefit cost ratio during this study (Table 7). The highest benefit cost ratio (1.9) was found from T_{10} treatment, while the lowest benefit cost ratio (1.01) recorded from T_0 treatment. From the economic point of view, it was apparent from the above result that among the different nutrient combination T_{10} treatment was more profitable than rest of treatment combinations.

Table 7. Cost and return of snake gourd cultivation as influenced by different levels of organic and inorganic fertilizers

Treatment	Cost of production	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Net return (Tk. ha^{-1})	Benefit cost ratio (BCR)
T_0	612118	14.72	618240	6122	1.01
T_1	842759	27.49	1154580	311821	1.37
T_2	1085352	35.92	1508640	423288	1.39
T_3	1059829	35.58	1494360	434531	1.41
T_4	1003961	37.29	1566180	562219	1.56
T_5	1033407	39.86	1674120	640713	1.62
T_6	1040694	41.38	1737960	697266	1.67
T_7	1055500	42.22	1773240	717740	1.68
T_8	1063668	42.80	1797600	733932	1.69
T_9	1070034	44.33	1861860	791826	1.74
T_{10}	1107473	50.10	2104200	996727	**1.9**

Total cost of production was done in details according to the procedure of Alam *et al.* (1989).

Sale of marketable part: 42000 Tk. per ton

Net return= Gross return - Total cost of production

Benefit cost ratio= Gross return / Total cost of production

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at Horticulture farm of Sher-e-Bangla Agricultural University to find out the effect of different level of organic and inorganic fertilizers on snake gourd. Results revealed that all vegetative and growth parameters of snake gourd were highest for the application of all nutrients.

Plant height showed an increasing trend up to flowering stage. The highest plant height recorded was 9.44, 69.36, 211.69, 234.51 cm at 15 DAS, vegetative stage, flowering stage and fruiting stage, respectively with the application of T_{10} treatment, while T_0 (Control) showed lowest plant height in all growth stages of snake gourd.

At 15 DAS, vegetative stage, flowering stage and fruiting stage of snake gourd maximum number of leaves per plant was recorded from T_{10} treatment, while T_0 (Control) showed minimum number of leaves per plant.

At vegetative stage, the highest leaf length of snake gourd (9.63 cm) was recorded from T_{10} treatment and the lowest leaf length (7.94 cm) was recorded from T_0 (control).

The number of branches at flowering stage showed positive response with different nutrient combinations. The maximum number of branches (10.02) was found from T_{10} treatment followed by T_9 (8.57) while minimum number of branches (4.95) was counted from T_0 treatment.

Different nutrient combinations noted significant influence on days required to first male flowering of snake gourd. The maximum days required to first male flowering (60.06 days) was observed in T_0 (control) treatment whereas minimum days required to first male flowering (47.97 days) was observed in T_{10} treatment.

Due to application of different nutrient combinations, the maximum days required to first female flowering (56.31 days) recorded in T_0 treatment while the minimum days required to first female flowering (44.68 days) observed from T_{10} treatment.

The highest number of male flower per plant (79.85) recorded from T_{10} treatment application whereas lowest number of male flowers per plant (55.98) was recorded from T_0 (control) treatment.

Experiment results showed that the maximum number of female flower per plant (25.65) was found from treatment T_{10}. On the other hand minimum number of female flowers per plant (15.67) was found from T_0 (control).

Results indicated that maximum days required for first fruiting of snake gourd (65.77 days) was recorded from T_0 (control) and the minimum days required for first fruiting of snake gourd (54.41 days) was recorded from T_{10}. The maximum number of fruits per plant (7.34) recorded from T_{10} treatment while minimum number of fruits per plant (3.48) counted from T_0 treatment.

Results signified that the highest fruit length (45.14 cm) was observed from T_{10} treatment and also revealed that the lowest fruit length was recorded from T_0 (34.74 cm) treatment.

Study results revealed that the maximum fruit diameter of snake gourd (3.55 cm) was recorded from T_{10} treatment while the minimum fruit diameter (2.72 cm) was observed from T_0 treatment.

Average fruit weight per plot showed positive influence by different nutrient combinations. Experiment results concluded that the highest average fruit weight per plot (406.47 gm) was recorded from T_{10} treatment, while lowest average fruit weight per plot (225.96 gm) was recorded from T_0 treatment.

The highest snake gourd yield per plot (11.69 kg) was recorded from T_{10} treatment and the lowest yield per plot (3.34 kg) was recorded from T_0 treatment.

Conclusion:

Experiment results concluded that different nutrient combinations have positive effect on yield of snake gourd. The highest yield (50.10 t ha^{-1}) was recorded from T_{10} treatment and the lowest yield (14.72 t ha^{-1}) was recorded from T_0 treatment.

Thus, it can be concluded that, application of different nutrient combinations on snake gourd helped to get higher vegetative growth and reproductive development as well as yield of snake gourd.

Recommendations:

1. The same experiment should have carried out in different AEZs of Bangladesh.
2. Before recommend to the farmers level, more research needed by increasing and decreasing the treatments.

REEFERENCES

Akter, S. (2017). Growth and yield of bitter gourd (*Momordica charantia* L.) Influenced by gibberelic acid and boron. MS thesis. Department of Horticulture, Sher-e-Bangla Agricultural University.

Alam, M. S., Iqbal, T. M. T., Amin, M. and Gaffar, M. A. (1989). Krishitattic Fasaler Utpadan O Unnayan (in Bengali). T. M. Jubair Bin Iqbal, Sirajgonj. *pp.* 231-239.

Alam, M. S., Iqbal, T. M. T.,Amin, M. and Gaffar, M. A. (1989). Krishitattic Fasaler Utpadan O Unnayan (in Bengali). T. M. Jubair Bin Iqbal, Sirajgonj. Pp. 231-239.

Arancon, N.Q., Edwards, C.A., Bierman, P., Welch, C. and Metzer, J. D. (2004). Influence of vermicomposts on field strawberries: effect on growth and yields. J. *Boi. Res.*, **93**: 145–153.

Arfan-ul-Haq, M., Ahmad, N., Farooq, U., Zafar, H. and Abd-Ali, M. (2015). Effect of different organic materials and chemical fertilizer on yield and quality of bitter gourd (*Momordica charantia* L.). *Soil Environ.*, **34**: 142-147.

Arora, S. K. and Satish, S. (1989). Effect of N and P on growth, flowering and sex expression of sponge gourd. *Horyana. Journal of Horticultural Sciences*. **18** (1-2): 106-112.

Arora, S. K. and Satish Siyag. (1989). Effect of N and P on growth, flowering and sex expression of sponge gourd. *Horyana Journal of Horticultural Sciences*. **18**(1-2): 106-112.

Arshad, I., Ali, W. and Khan, Z. A. (2014). Effect of different levels of NPK fertilizers on the growth and yield of greenhouse cucumber *(Cucumis sativus* L.) by using drip irrigation technology. *International Journal of Research.* **1**: 650-660.

Ayoola, O. T. and Adeniran, O. N. (2006). Influence of poultry manure and NPK fertilizer on yield and yield components of crops under different cropping systems in South West Nigeria. *Afr. J. Biotechnol*. **5**: 1336- 1392.

Ayuso, M. A., Pascal, J. A., Garcia, C. and Hernandez, T. (1996). Evaluation of urban wastes for urban agricultural use. *Soil Sci. Plant Nutri*. **42**:105- 111.

Bano, K., Kale, R. D., and Gajanan, G. N. (1987). Culturing of earthworm Eudrilus eugeniae for cast production and assessment of worm cast as biofertilizer. *Journal of Soil Biology and Ecology*. **7**(2): 98-104.

BBS, (2019). Year Book of Agricultural Statistics of Bangladesh, 2019. Bangladesh Bureau of Statistics. Ministry of Planning. Govt. of the people's Republic of Bangladesh. Dhaka.

BBS, (2021). Year Book of Agricultural Statistics of Bangladesh, 2021. Bangladesh Bureau of Statistics. Ministry of Planning. Govt. of the people's Republic of Bangladesh. Dhaka.

Belay, A., Classens, A. S., Wehner, F. C., and De Beer, J. M. (2001). Influence of residual manure on selected nutrient elements and microbial composition of soil under long term crop rotation. *S. Afr. J. Plant Soil*. **18**: 1-6.

Boonmanop, S. (1997). Influences of nitrogen, phosphorus and potassium fertilizers on seed yield, yield and seed quality of bitter gourd. Bull, Kasetsart Univ. Bangkok, Thailand. *Pp*. 711-729.

Brantley, B. B., and Warren, G. F. (1960). Sex expression and growth in muskmelon. *Plant physiology*. **35**(5): 741.

Catedral, I. G. (1974). Seed production studies in Ampalaya. MS Thesis, UPLB College, Laguna, The Philippines.

Chakrabarti, A. K. (1982). Fasicles of Flora of India II. Cucurbitaceae. Botanical Survey of Hawra. W.B. pp. 136.

Choudhury, B. and Phatak, S. C. (1959). Sex expression and fruit development in cucumber (Cucumis sativus L.) as affected by gibberellin. *Indian Journal of Horticulture*. **16**(4): 233-235.

Clementina, U. (2013). The Impact of Organic and Inorganic Manure on the Cultivation of Pumpkin (*Cucurbita maxima*). *Journal of Pharmacy and Biological Sciences.* **8**:18-20.

Costa, F. A., García, C., Hernández, T., and Polo, A. (1991). Residuos orgánicos urbanos. *Manejo y Utilización. Ed.: CSIC-CEBAS. Murcia*.

De Datta. S. K. (1981). Mineral nutrition and fertilizer management of rice. Principles and Practices of Rice Production, New York. pp. 318-319.

Edris, K. M., Islam, A. T. M. T., Chowdhury, M. S. and Haque, A. K. M. M. (1979). Detailed Soil Survey of Bangladesh, Dept. Soil Survey, Govt. People's Republic of Bangladesh. *pp.* 118.

Eifediyi, E. K. and Remison, S. U. (2009). The effects of inorganic fertilizer on the yield of two varieties of cucumber (*Cucumis sativus* L.). *Report and Opinion.* **1**:74-80.

Eifediyi, E. K., Remison, S. U., Ahamefule, H. E., Azeez, K. O. and Fesobi, P. O. (2017). Performance of watermelon (Citrullus lanatus L.) in response to organic and NPK fertilizers. *Acta Universitatis Sapientiae Agriculture and Environment*. **9**: 5-175.

El-Shakweer, M. H. A., El-Sayad, E. A., and Ewees, M. S. A. (1998). Soil and plant analysis as a guide for interpretation of the improvement efficiency of organic conditioners added to different soils in Egypt. *Communications in Soil Science and Plant Analysis*. **29**(11-14): 2067-2088.

Embiowei, S. E. and Emiri, U. N. (2015). Evaluation of organic and inorganic fertilizers on the yield and yield components of cucumber under different irrigation regimes and cropping seasons. *International Journal of Science and Research (IJSR).* **6**(5): 363-377.

Esmaielpour, B., Einizadeh, S. and Porrahimi, G. (2020). Effects of vermicompost produced from cow manure on the growth, yield and nutrition contents of cucumber (*Cucumis sativus*). *Journal of Central European Agriculture*. **21**(1): 104-112.

FAO, (1988). Production Year Book. Food and Agriculture Organizations of the United Nations. Rome, Italy. *Pp*.190-193.

Fuchs, W., Rauhe, K., and Wicke, H. J. (1970). Effects of organic manure, mineral fertilizers and organo-mineral fertilizing on development and yield of cereals. *Albrecht-Thaer-Arch.* **14**: 359-366.

Gedam, V. M., Patil, R. B., Suryawanshi, Y. B., and Mate, S. N. (1998). Effect of plant growth regulators and boron on flowering, fruiting and seed yield in bitter gourd. *Seed Research*. **26**(1): 97-100.

Ghasem, S., Morteza, A. S. and Maryam, T. (2014). Effect of organic fertilizers on cucumber (*Cucumis sativus*) yield. *International Journal of Agriculture and Crop Sciences.* **7**: 808-814.

Ghayal, R. G. (2016). Effect of different organic and inorganic fertilizers on yield and quality of cucumber (Cucumis sativus L.) and some soil properties. A M.Sc. (SSAC) thesis submitted to Dr. B. S. K. K.V, Dapoli.

Ghorbani, R., Jahan, M., Koocheki, A., Nassiri, M. and Salari, M. D. (2013). The effects of manure application and branch management methods on some agro ecological aspects of summer squash (*Cucurbita pepo* L.) in a low input cropping system. *International Journal of Agricultural Sciences.*, **3**: 428- 434.

Gopalan, C., Rama Sastri, B. V. and Balasubramanian, S. C. (1985), Nutritive value of Indian foods, National Institute of Nutrition, ICMR, New Delhi.

Hafez, S. K., El-Beik, A. K., El-Tantawy, E. M. and El-Kassas, A. I. (2016). Effect of organic and bio-fertilizer sources on summer squash under El-Arish conditions. *SINAI Journal of Applied Sciences*. **5**(2): 155-172.

Hamma, I. L., Ibrahim, U. and Haruna, M. (2012). Effect of poultry manure on the growth and yield of cucumber (Cucumis sativum L.) in Samaru, Zaria. *Nigerian J of Agri, Food and Environment.* **8**(1):94-98.

Hong-mei, Z., Hai-jun, J., Xiao-tao, D. and Ting, H. (2014). Effects of application of organic and inorganic fertilizers on the growth, yield quality of cucumber in greenhouse. *J of P N and Fertilizer*. Pp. 247-253.

Ikeh, A. O., Udoh, E. I., Uduak, G. I., Udounang, P. I. and Etokeren, U. E. (2012). Response of cucumber *(Cucumis sativus* L.*)* to different rates of goat and poultry manure on an ultisol. *Journal of Agriculture and Social Research (JASR)*. **12**(2): 132-139.

Islam, M. S. (1995). Seed production studies on bitter gourd (Momordica charantia L.) Ph. D Thesis, CLSU, Munoz, Nueva Ecija, the Philippines.

Issac, S. R. and Pusphakumari, R. (1997). Effect of green fruit picking and nutrient sources on the seed production of okra (*Abelmoschus esculentus* L. *Monech*.). *Seed Research.* **25**(1): 83-85.

Jamir, S. Y., Topno, S. E. and Bahadur, V. (2022). Effect of organic and inorganic fertilizers on growth, yield & quality of cucumber (*Cucumis sativus* L.) under Protected Cultivation. *International Journal of Plant & Soil Science IJPSS.* 34(21): 723-728.

Jianming, L., Putea, W., Behboudianc, M. H., Zhonghongd, W. and Mortonc, A. (2008). Response of cantaloupe to cattle or sheep manure compost mixed with sandy soil. *J Organic* Sys., **3**: 261-269.

Jilani, M. S., Bakar, A., Waseem, K. A. and Kiran, M. (2009). Effect of different levels of NPK on the growth and yield of cucumber (*Cucumis sativus* L.) under the plastic tunnel. *Journal of Agriculture and Social Sci*ence. **5**: 99- 101.

Kang, B. T. (1981). Management of low activity clay soils in tropical Africa for food crop production. In *Workshop, Kigali, Rwanda, June 2-12, 1981. pp*. 45-53.

Kannan, P., Saravanan, A. and Balaji, T. (2006). Organic farming on tomato yield and quality. *J. Acta. Sci. Pol. Research. Crop.* **32**(2):196-200.

Katyal, J. C. and Randhawa, N. S. (1983). Micronutrients. FAO Fertilizer and Plant Nutrition Bulletin. No. 7. Rome, Italy.

Kaur, A. and Rattan, P. (2021). Effect of Organic Manures and Chemical Fertilizers on the Growth, Yield and Quality Traits of Summer Squash (*Cucurbita pepo* L.)" *cv.* Punjab ChappanKaddu. *International Journal of Environment and Climate Change.***11**(4): 142-152.

Khan, M., Ullah, F., Zainub, B., Khan, M. N., Zeb, A., Ahmed, K. and Arshad, I. R. (2017). Effects of poultry manure levels on growth and yield of cucumber cultivars. *Sci.Int.(Lahore).* **29**(6): 1381-1386.

Khanum, M. M., Nuruzzaman, M., Huda, M. S., Muzahid, M. A. A. A. (2021). Effect of organic manures and planting time on growth, yield, quality and economics of squash under medium high land condition of Dinajpur region. *Sustainability in Food and Agriculture.* **2**(1): 40-43.

Kumar, K. M., Somasundaram, E., Marimuthu, S. and Meenambigai, C. (2017). Growth, yield and quality of snake gourd (*Trichosanthes anguina* L.) as influenced by organic nutrient management practices. *Int. J. Curr. Microbiol. App. Sci.,* **6**(11): 918-924.

Kumar, P. T., Bonny, B. P., Midhila, R., John, R., Divya, M. R. and Roch, C. V. (2017). Effect of organic and inorganic nutrient sources on the yield of selected tropical vegetables. *Scientia Horticulture.* **224**: 84-92.

Law, K. E. O. and Osaigbovo, A. U. (2018). Productivity of cucumber (*Cucumis sativus* L) and postharvest soil chemical properties in response to organic fertilizer types and rates in an ultisols. *Tropical and Subtropical Agroecosystems*. **21**(1): 513 – 520.

Lingaiah, H. B., Uthaiah, B. C., Herle, P. S. and Rao, K. B. (1988). Influence of nitrogen and phosphorus on the yield of bitter gourd in the coastal region of Karnataka. *Current Res. Univ. Agri. Sci. Bangalore India*. Pp. 107-116.

Linglc, J. C. and Wight. J. R. (1964). Fertilizer experiment with cantaloupe. Bull. Calif. Agric. Expt. Sta, 807: 22.

Mahale, A. G., Dodake, S. B., Kasture, M. C., Jadhav, S. C., Raut, S. V. and Kambale, N. A. (2018). Effect of integrated nutrient management on snake gourd (*Trichosanthes anguina* L.) in lateritic soils of Konkan. *Journal of Pharmacognosy and Phytochemistry.* **7**(5): 1114-1118.

Makal, K. G., Joshi, A. T., Deshmukh, P. O. and Pawar, P. R. (1977). Effect of N, P and K on tinda (*Citrullus vulgaris* var. fistulosus*). Orissa J. Hort*., **5**(1/2): 62-63.

Makinde, E. A., Ayoola, O. T., and Akande, M. O. (2007). Effects of organo-mineral fertilizer application on the growth and yield of egusi melon. *Australian Journal of Basic and Applied Sciences*. **1**(1): 15-19.

Marinari, S., Masciandaro, G., Ceccanti, B. and Grego, S. (2000). Influence of organic and mineral fertilizers on soil biological and physical properties. *Bioresour. Technol.* **72**: 9-17.

Martius, C., Tiessen, H., and Vlek, P. L. G. (2001). The management of organic matter in tropical soils: what are the priorities. In *Managing organic matter in tropical soils: Scope and limitations* (pp. 1-6). Springer, Dordrecht.

Matzusaki, A. and Hayasc. H. (1963). Studies on the fruit growth of cucumber in relation between fruit set and N supply. *J. Jap. Soc. Hort. Sci*. **32**: 121- BO.

McMurray, A. L., and Miller, C. H. (1969). Effect of 2-chloroethanephosphonic acid (Ethrel) on the sex expression and yields of Cucumis sativus. In *Proc Amer Soc Hort Sci*. **1**(1): 16-21.

Mehdizadeh V. K., Yadlod, S. S., Tambe, T. B. and Narsude, P. B. (2013). Effect of foliar application of micronutrients on flowering and fruit set of tomato *cv*. Phule raja. Inter. *J. of Agri. Sci.* **6**(1): 164-166.

Memon, K. S. (1996). Soil and Fertility Phosphorus. In: A. Rashid and K. S. Memon. (Auth). 291-314. pp

Mia, M. B., Islam, M. S., and Shamsuddin, Z. H. (2014). Altered sex expression by plant growth regulators: An overview in medicinal vegetable bitter gourd (Momordica charantia L.). *Journal of Medicinal Plants Research*. **8**(8): 361-367.

Mishra, M. M. and Bangar, K. C. (1986). Rock Phosphate composting: Transformation of phosphorus forms and mechanism of solubilization. *Biol. Agric. Hort.,* **3**: 331-340.

Mkhabela, S. N., Mavuso, C. S., Masarirambi, M. T. and Wahome, P. K. (2020). The effects of different organic fertilizers on the vegetative growth and fruit yield of baby marrow (*Cucurbita pepo* L.) in Luyengo, Eswatini. *International Journal of Development and Sustainability*. **9**: 49-67.

Momin, M. A. (2007). Effect of growth regulators and fertilizer management practices on the flowering, fruit set and yield of bitter gourd (*Momordica charantia* L.). MS thesis. Department of Horticulture, Sher-e-Bangla Agricultural University.

Moral, R., Paredes, C., Bustamante, M. A., Marhuenda-Egea, F. and Bernal, M. P. (2009). Utilisation of manurecomposts by high-value crops: Safety and environmental challenges. *Bioresource Technology*. **100**: 5454-5460.

Murwira, H., and Kirchmann, H. (1993). Carbon and nitrogen mineralization of cattle manures, subjected to different treatments, in Zimbabwean and Swedish soils.

Nagavallemma, K. P., Wani, S. P., Stephane, L., Padmaja, V. V., Vineela, C., Babu, R. M. and Sahrawat, K. L. (2004). Vermicomposting: Recycling wastes into valuable organic fertilizer. Global theme on agro ecosystems Report no. 8. Patancheru 502324, Andhra Pradesh, India. *Int. Crops Research Inst. for the Semi-Arid Tropics*. **2**(1):1-20.

Naik, L. B. and Srinivas, K. (1992). Influence of nitrogen and phosphorus fertilization on seed crop of okra (Hibiscus esculentus). *Indian J. Agron*., **37**(4): 769-771.

Nair, S. K., Naseema, A., Meenakumari, S. K., Prabhakumari, P. and Peethambaran, C. K. (1997). Micro flora associated with earthworms and vermicomposting. *J. Tropical Agri.*, **35**: 93-98.

Nason, A. and Mc. Elrory, W. D. (1963). Modes of action of the essential mineral elements. In: F.C. Steward, (ed.) Plant physiology, Academic Press, New York. pp.138-139.

Natsheh, B. and Mousa, S. (2014). Effect of organic and inorganic fertilizers application on soil and cucumber (*Cucumis sativa* L.) plant productivity. *International Journal of Agriculture and Forestry.* **4**(3): 166-170.

Obi, M. E., and Ebo, P. O. (1995). The effects of organic and inorganic amendments on soil physical properties and maize production in a severely degraded sandy soil in southern Nigeria. *Bioresource Technology*. **51**(2-3): 117-123.

Oga, I. O. and Umekwe, P. N. (2013). Effects of NPK fertilizer and staking methods on the growth and yield of watermelon (*Citrullus lanatus* L.). *International Journal of Scienceand Research.* **23**: 19- 64.

Ogunremi, E. A. (1978). Effect of nitrogen on melon (Citrullus lanatus) at lbadan, *Nigeri. Hort.*,**32**(1): 11-14.

Ojeniyi, S. O. (2000). Effect of goat manure on soil nutrients and okra yield in a rain forest area of Nigeria. *Applied Tropical Agriculture*. **5**(1): 7-12.

Ojo, J. A., Olowoake, A. A., Obembe, A. (2014). Efficacy of organomineral fertilizer and un-amended compost on the growth and yield of watermelon (*Citrullus lanatus* Thumb) in Ilorin Southern Guinea Savanna zone of Nigeria. *Int J Recycl Org Waste Agriculture.* **3**: 121–125.

Okee, J. I., Agbaji, F. and Akogu, S. E. (2020). Effect of Organic Manure on the Growth of Cucumber in Anyigba, Kogi State, Nigeria. *International Journal of Agricultural Economics, Management and Development (IJAEMD).* **8**(2): 172-182.

Okoli, P. S. O. and Nweke, I. A. (2015). Effect of poultry manure and mineral fertilizer on the growth performance and quality of cucumber fruits. *Journal of Experimental Biology and Agricultural Sciences.* **3**: 362-367.

Orluchukwu, J. A. and Amadi, C. (2022). Effect of organic and inorganic fertilizers on the growth and yield of cucumber (*Cucumis sativa L.*) in South-South Nigeria. *Int. J. Agric. Pol. Res.*,**10**(2): 31-37.

Pandey, R. P. and Singh. K. (1973). Note on the effect of nitrogen and maleic hydrazide on sex expression, sex ratio and yield of bottle gourd. *Indian. J.Agril. Sci.,* **43**(9): 882-883.

Pandey, R. P., Singh, K. and Tiwari, J. P. (1976). Effect of growth regulators on sex expression, fruit set and yield of sponge gourd (*Lagenaria cylindrical* Poem). *Res. J.,* **10**(1): 1-4.

Parthasarthi, K. and Ranganatahn, L. S. (2002). Supplementation of presumed vermicast with NPK enhances growth and yield in Leguminous crop (*Vigna mungo* and Arachishypogaea). *J. Current Sci.* **2**: 35-41.

Patnaik, A., Mishra, R. S., Nayak, G. C. and Maharana, T. (1974). Effect of Cococel and Ethrel on sex expression and yield of Ridge gourd. *Bangladesh Horticulture*. **2**: 19-22.

Pelaez, R. J., Calero De La Pava, C. and Jaramillo, V. (1984). Response of squash (*Cucurbita pepo* L.) and organic matter. *Acta Agronomica*. **34**(3): 86-95.

Podder, R., Rasul, M. G., Islam, A. K. M. A., Mian, M. A. K. and Ahmed, J. U. (2010). Combining ability and Heterosis in Snake gourd (*Tricosanthes cucumminata* L). *Bangladesh J. Pl. Breed. Genet*. **23**(2): 01-06.

Pokhrel, B., Laursen, K. H. and Petersen, K. K. (2015). Yield, Quality, and Nutrient Concentrations of Strawberry (Fragaria x ananassa Duch. *cv*. „Sonata‟) Grown with Different Organic Fertilizer Strategies. *J. Agric. Food Chem*., **63**(23): 5578–5586.

Prasad, A., and Tyagi, J. D. (1963). Effect of maleic hydrazide on the sex expression and sex ratio in bitter gourd. *Sci. and Cult*., **29**(12): 605-6.

Rahman, M. (2006). Effects of growth regulator and fertilizer management practices on the growth, flowering and yield of bitter gourd (*Momordica charantia* L.). MS thesis. Department of Horticulture, Sher-e-Bangla Agricultural University.

Rai, R. (1992). Effect of acidity factors on aspects of symbiotic N_2 fixation of *Lens vulinaris* in acid soils. *J Gen Appl Microbiol*., **38**: 391–406.

Rasool, A., SharifiZ-iveh, P. and Satari, M. R. (2008). Effect of vermicompost on growth, yield and nutrition status of tomato. *Pakistan J. Bio. Sci*., **11**(14): 1797-1802.

Ravindran, D. N. (1971). Effect of photopeiod and growth substances on sex expression in snake gourd (Trichosanthes anguina L.). *South Indian Hort*., **15**: 1-21.

Reddy, P. K and Rao, P. V. (2004). Growth and yield of bitter gourd (*Momordica charantia* L.) as influenced by vermicompost and nitrogen management practices. *Indian J. Res.* **32**(3): 15-20.

Rekha, C. R. and Gopalakrisnan, J. R. (2001). Effect of levels and frequencies of organic manures and inorganic fertilizers on growth and productivity of bitter gourd (*Mamordica charantia* L.). *South Indian Horticulture*. **49**: 137-139.

Satish, S. S., Arora, K. and Siyag, S. (1988). Effect of nitrogen and phosphorus on fruit yield and quality of sponge gourd (*Lagenaria aegytiaca*). *Indian J. Agril. Sci.* **58**(11): 860-861.

Seshardi, V. S. (1986). Cucurbits. In: Vegetable Crops in India, edited by T. K. Bose and M. G. Som. 1986. Naya Prokash, Calcutta, India. *Pp.* 91-166.

Shafeek, M. R., Shaheen, A. M., Abd El-Samad, E. H., Rizk, F. A. and Abd El-Al, F. S. (2015). Response of Growth, Yield and Fruit Quality of Cantaloupe Plants (*Cucumis melo* L.) to Organic and Mineral Fertilization. *Middle East Journal of Applied Sciences.* **5**: 76-82.

Singh, A., Prasad, D. V. M., Bahadur, D. V. and Topno, D. S. (2021). Effect of organic and inorganic fertilizer on growth, yield and quality traits of cucumber (*Cucumis sativus*) under Prayagraj Agro-climatic condition. *The Pharma Innovation Journal.* **10**(7): 1293-1296.

Singh, C. P. and Amberger, A., (1991). Solubilization and availability of phosphorus during decomposition of phosphate rock enriched straw and urine. *Biological Agriculture and Horticulture.* **7**: 261–269.

Singh, H. P. and Singh, T. N. (2004). Effect of sources and levels of zinc on growth, yield and mineral composition of rice in alkali soil. *Indian Journal of Plant Physiology.* **9**(4): 378–382.

Singh, R., Sharma, R. R., and Singh, D. B. (2010). Effect of vermicompost on plant growth, fruit yield and quality of strawberries in irrigated arid region of northern plains. *Indian journal of Horticulture.* **67**(3): 318-321.

Singh, V., Prasad, V. M., Kasera, S., Singh, B. P. and Mishra, S. (2017). Influence of different organic and inorganic fertilizer combinations on growth, yield and quality of cucumber (*Cucumis sativus* L.) under protected cultivation. *Journal of Pharmacognosy and Phytochemistry.* **6**(4): 1079-1082.

Singh, V., Singh, A., Metha, V. S. (1995). Effect of sulfur sources and levels on yield and uptake of nutrients by garlic. *Fertilizer News*. **40**: 47–49.

Song, C., Xiao-ri, H. and Guo-yuan, Z. (2006). Effect of different rate of organic fertilizer on growth of cucumber and its nutrients uptake. *Acta Agriculturae BorealiSinica.* **21**: 125-128.

Sreenivas, C., Muralidhan, S. and Rao, M. S. (2000). Yield and quality of ridge gourd fruits as influenced by different level of inorganic fertilizers and Vermicompost. *Annals of Agricultural Research*. **21**: 262-266.

Sreeramulu, N. (1987). Effect of ethrel on sex expression and endogenous auxin content in sponge gourd (*Luffa cylindrica* Poem). *Indian Journal of Horticulture*. **44**(1&2): 85-87.

Subbaiah, K., Sundararajan, S. and Raniperumal (1985). Response of tomato and brinjal to varying levels of FYM and micronutrients under fertility status of soil. *South Indian Horticulture*. **33**: 198-205.

Suresh, J., and Pappiah, C. M. (1991). Growth and yield of bitter gourd as influenced by nitrogen, phosphorus and maleic hydrazide. *South Indian Hort*., **38**(3): 158.

Tadano, T. (1985). Nutritional factors limiting crop growth in problem soils and crop tolerance to them. In Proceedings of International Seminar on Environmental Factors in Agricultural Production, Thailand. pp. 329-345.

Tahir, S. M., Kabir, A. M., Ibrahim, H. and Sufiyanu, S. (2019). Studies on the performance of organic and inorganic fertilizer on the growth and yield of cucumber (*Cucumis sativus* L.). *Science World Journal*. **14**(1): 156-163.

Titiloye, E. O. (1982). *The chemical composition of different sources of organic wastes and effects on growth and yield of maize* (Doctoral dissertation, Ph. D. thesis University of Ibadan, Nigeria).

Tsuchiya, T. and Gupta, P. K. (1991). Chromosome Engineering in Plants: Genetics Breeding Evolution. Elsevier. Amsterdam.

Umamaheshwarappa, P., Nachegowda, V. and Murthy, P. V. (2005). Uptake of nitrogen, phosphorous, potassium and fruit size of cucumber *Cv.* Poinsette as influenced by different levels of NPK fertilizers. *Karnataka Journal of Horticulture.* **1**: 76-80.

UNDP, (1988). Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2: Agro-ecological Regions of Bangladesh, FAO, Rome. *pp.* 212.

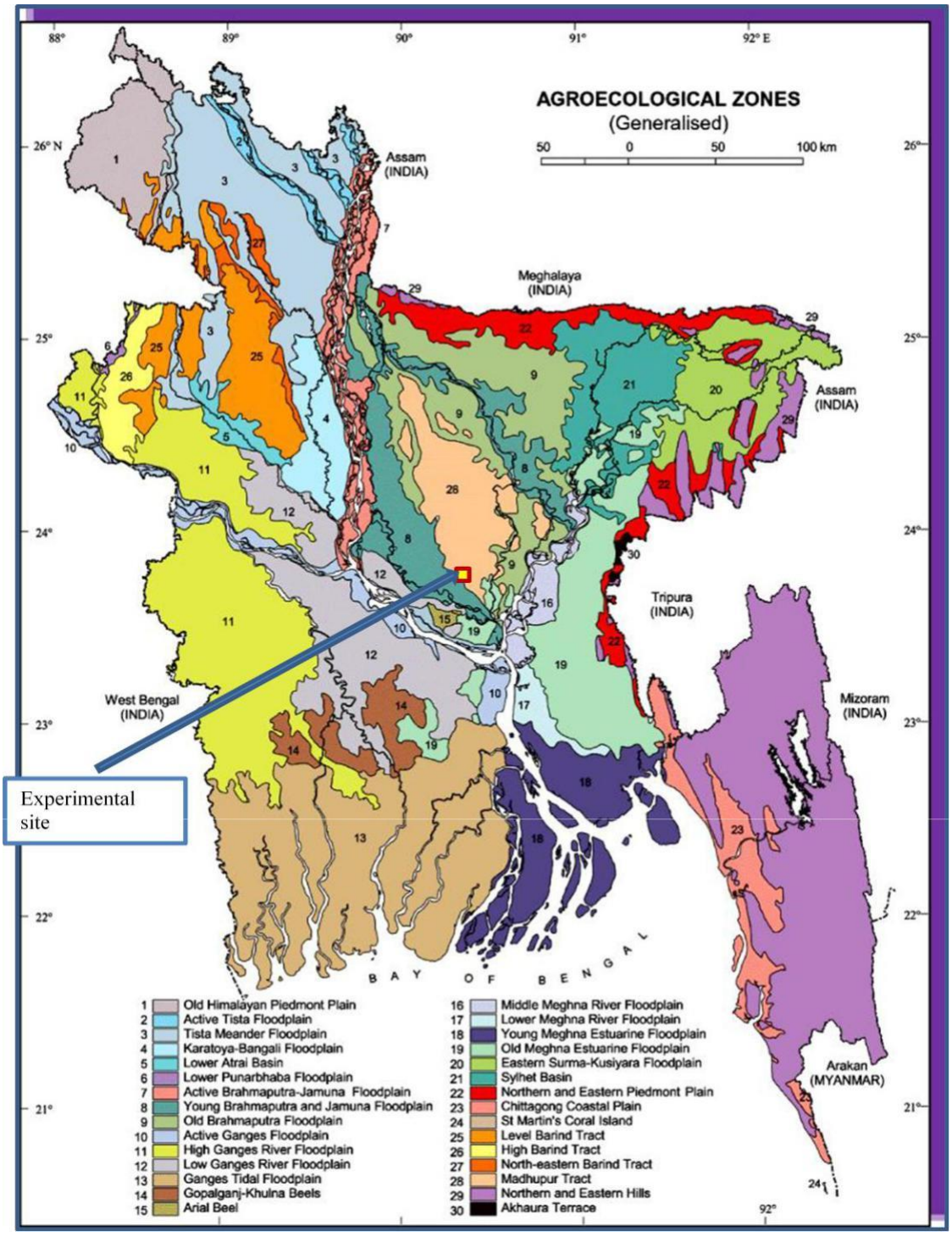
Vishnu, S. H., Prabhakar, B. S. and Sukla, V. (1987). Effect of plant spacing and fertilizer on yield of bottle gourd. *South Indian Hort*. **35**(6): 453-454.

Weinberger, K. and Genova, C. A. (2005). Vegetable production in Bangladesh: commercialization and rural livelihoods. AVRDC-World Vegetable Center.

Yawalkar, K. S., Agrawal, J. P. and Bokde, S. (1984). Manures and Fertilizers. Agri. Horticultural Publishing House, Nagpur-440010, India. pp. 29-85.

APPENDICES

Appendix I. Map showing the experimental site



Appendix II: Characteristics of Sher-e-Bangla Agricultural University soil is analysed by Soil Resources Development Institute (SRDI), Khamar Bari, Farmgate, Dhaka.

A. Morphological characteristics of the experimental filed

Morphological features	Characteristics
Location	Sher-e-Bangla Agricultural University
AEZ	Madhupur Tract (28)
General soil type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Fellow-Tomato

B. Physical and chemical properties of initial soil

Characteristics	Value
Particle size analysis	
% Sand	27
% Silt	43
% Clay	30
Textural class	
pH	5.47-5.63
Organic carbon (%)	0.46
Organic matter (%)	0.83
Total N (%)	0.05
Available P (ppm)	20.00
Exchangeable K (me/100 gm soil)	0.12
Available S (ppm)	46

Source: Soil Resources Development Institute (SRDI)

Appendix III. Monthly record of annual temperature, rainfall, relative humidity, soil temperature and sunshine of the experimental site during the study period from March 2020 to July 2020 (Site: Dhaka)

Year	Month	Air temperature			Relative humidity (%)	Rainfall (mm)	Sunshine
		Max.	Mini.	Average			
2020	March	31.35	21.76	28.25	62.04	00	20.33
	April	34.56	24.2	27.40	74.82	68.5	206.9
	May	29.85	18.50	24.17	70.12	00	235.2
	June	26.76	16.72	21.74	70.63	00	190.5
	July	33.56	22.10	27.17	73.82	40.5	208.2

Source: Bangladesh Meteorological Department (Climatic Division), Agargaon, Dhaka- 1212.

Appendix IV. Analysis of variance of the data on vine length (cm) at different growth stages of snake gourd as influenced by different levels of organic and inorganic fertilizers application.

Source of variation	Degree of freedom	Mean square		
		Vine length (cm) at different growth stages		
		Vegetative stage	Flowering stage	Fruiting stage
Replication	2	0.236	89.07	124.28
Treatment	10	244.555*	3544.01*	4334.76*
Error	20	10.926	108.64	123.09

* : Significant at 0.05 level of probability

Appendix V. Analysis of variance of the data on number of leaves plant^{-1} at different growth stages of snake gourd as influenced by different levels of organic and inorganic fertilizers application.

Source of variation	Degree of freedom	Mean square		
		number of leaves plant^{-1} at different growth stages		
		Vegetative stage	Flowering stage	Fruiting stage
Replication	2	89.142	59.014	38.778
Treatment	10	209.656*	495.261*	585.314*
Error	20	21.278	36.197	46.024

* : Significant at 0.05 level of probability

Appendix VI. Analysis of variance of the data on leaf length at vegetative stage (cm), no. of branches at flowering stage, days required to first male flowering and days required to first female flowering of snake gourd as influenced by different levels of organic and inorganic fertilizers application.

Source of variation	Degree of freedom	Mean square			
		Leaf length at vegetative stage (cm)	No. of branches at flowering stage	Days required to first male flowering	Days required to first female flowering
Replication	2	0.90072	0.06568	41.9271	5.8160
Treatment	10	0.82000*	6.71979*	49.5502*	54.8804*
Error	20	0.19973	0.21917	24.8060	11.7061

* : Significant at 0.05 level of probability

Appendix VII. Analysis of variance of the data on number of male flowers plant^{-1}, number of female flowers plant^{-1}, days required for first fruiting and number of fruits plant^{-1} of snake gourd as influenced by different levels of organic and inorganic fertilizers application.

Source of variation	Degree of freedom	Mean square			
		Number of male flowers plant^{-1}	Number of female flowers plant^{-1}	Days required for first fruiting	Number of fruits plant^{-1}
Replication	2	157.162	1.2145	71.7431	0.09281
Treatment	10	152.958*	30.2058*	46.9399*	4.48293*
Error	20	23.937	0.7899	9.3786	0.06232

* : Significant at 0.05 level of probability

Appendix VIII. Analysis of variance of the data on fruit length (cm), fruit diameter (cm) and average fruit weight (gm) of snake gourd as influenced by different levels of organic and inorganic fertilizers application.

Source of variation	Degree of freedom	Mean square		
		Fruit length (cm)	Fruit diameter (cm)	Average fruit weight (gm)
Replication	2	32.3755	0.09222	562.42
Treatment	10	34.9944*	0.26343*	9489.99*
Error	20	13.1022	0.11095	292.78

* : Significant at 0.05 level of probability

Appendix IX. Analysis of variance of the data on yield plot^{-1} (kg) and yield (t ha^{-1}) of snake gourd as influenced by different levels of organic and inorganic fertilizers application.

Source of variation	Degree of freedom	Mean square	
		Yield plot^{-1} (kg)	Yield (t ha^{-1})
Replication	2	0.1306	1.2145
Treatment	10	14.3491*	270.426*
Error	20	0.1865	2.181

* : Significant at 0.05 level of probability

A

B

Plate 1. Pictorial presentation of different operations during land preparation A. Seed sowing in experimental filed B. Fertilizer application in experimental plot.

A

B

C

D

E

F

Plate 2. Pictorial presentation of different growth stages of snake gourd in experimental plot. A. Seed germination, B. Seedling, C. Standing crop in experimental plot, D. Flowering stage, E. Fruiting stage, F. Maturity stage.

Plate 3. Pictorial presentation of harvested snake gourd fruit from different experimental plots