# INFLUENCE OF DIFFERENT COMBINATION OF INORGANIC AND ORGANIC FERTILIZERS IN SESAME

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**MASTER OF SCIENCE**

**IN**

**AGRONOMY**

**DEPARTMENT OF AGRONOMY**

**SHER-E-BANGLA AGRICULTURAL UNIVERSITY**

**DHAKA-1207**

**JUNE, 2016**

# INFLUENCE OF DIFFERENT COMBINATION OF INORGANIC AND ORGANIC FERTILIZERS IN SESAME

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**REGISTRATION NO. 10-03888**

**A Thesis**

*Submitted to the Faculty of Agriculture*

*Sher-e-Bangla Agricultural University, Dhaka*

*in partial fulfilment of the requirements*

*for the degree of*

**MASTER OF SCIENCE**

**IN**

**AGRONOMY**

**SEMESTER: JANUARY-JUNE, 2016**

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# *CERTIFICATE*

This is to certify that the thesis entitled ***"INFLUENCE OF DIFFERENT COMBINATION OF INORGANIC AND ORGANIC FERTILIZERS IN SESAME"*** submitted to the Faculty of Agriculture**,** Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of ***MASTER OF SCIENCE (MS)*** in ***AGRONOMY,*** embodies the results of a piece of *bona fide* research work carried out by ***ROKEYA SULTANA RUKU,*** Registration. No. ***10-03888*** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information as has been availed of during the course of this investigation has duly been acknowledged.

Dated:

Dhaka, Bangladesh

**(Prof. Dr. A. K. M. Ruhul Amin)**

**Supervisor**

# ACKNOWLEDGEMENTS

Alhamdulillah, all praises are due to the almighty ***Allah Rabbul Al-Amin*** for His gracious kindness and infinite mercy in all the endeavors the author to let her successfully completes the research work and the thesis leading to Master of Science.

The author would like to express her heartfelt gratitude and most sincere appreciations to her Supervisor ***Prof. Dr. A. K. M. Ruhul Amin***, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, for his valuable guidance, advice, immense help, encouragement and support throughout the study. Likewise grateful appreciation is conveyed to Co-supervisor ***Dr. Mirza Hasanuzzaman, Associate Professor,*** Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, for his constant encouragement, cordial suggestions, constructive criticisms and valuable advice to complete the thesis.

The author would like to express her deepest respect and boundless gratitude to all the respected teachers of the Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, for their valuable teaching, sympathetic co-operation, and inspirations throughout the course of this study and research work.

The author wishes to extend her special thanks to her class mates and friends their for their keen help as well as heartiest co-operation and encouragement during experimentation. Special thanks to all other friends for their support and encouragement to complete this study.

The authoress is deeply indebted and grateful to her parents, brothers, sisters who continuously prayed for her success and without whose love, affection, inspiration and sacrifice this work would not have been completed. Also thankful to NST fellowship for valuable recognization. May Allah bless and protect them all.

Finally the author appreciates the assistance rendered by the staff members of the Department of Agronomy, Sher-e-Bangla Agricultural University Farm, Dhaka, who have helped her during the period of study.

*The author*

## INFLUENCE OF DIFFERENT COMBINATION OF INORGANIC AND ORGANIC FERTILIZERS IN SESAME


# ABSTRACT

An experiment was conducted at the Sher-e- Bangla Agricultural University Farm, Dhaka-1207 during Kharif-1 from March 2015 to June 2015 to evaluate the influence of different combinations of organic and inorganic fertilizer in sesame. The experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. There were 12 treatments such as- $T_0$ = control, $T_1$ = chemical fertilizer, $T_2$ = mixed fertilizer, $T_3$ = cowdung + 25% FRD (FRD = Fertilizer at Recommended Dose), $T_4$ = vermicompost + 25% FRD, $T_5$ = poultry manure + 25% FRD, $T_6$ = cowdung + 50% FRD, $T_7$ = vermicompost + 50% FRD, $T_8$ = poultry manure + 50% FRD, $T_9$ = cowdung + 75% FRD, $T_{10}$ = vermicompost + 75% FRD, $T_{11}$ = poultry manure + 75% FRD. The results of the experiment revealed that plant height, number of branches plant$^{-1}$, dry matter weight plant$^{-1}$, number of capsules plant$^{-1}$, number of seeds capsule$^{-1}$, 1000 seed weight, seed yield, stover yield, biological yield and harvest index were significantly influenced by different combinations of organic and inorganic fertilizers. The highest number of capsules plant$^{-1}$ (88.93), number of seeds capsule$^{-1}$ (68.67), 1000 seed weight (2.83g), seed yield (1656.4 kg ha$^{-1}$), stover yield (2309.82 kg ha$^{-1}$), harvest index (42.35%) were fonud from the application of chemical fertilizer which were statistically similar with the treatment combination comprised of poultry manure + 75% FRD and vermicompost + 75% FRD. So treatment of poultry manure + 75% FRD and vermicompost + 75% FRD seems to be promosing in sesame cultivation which reduced the 25% chemical fertilizer use.

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| | | |
|---|---|---|
| AEZ | = | Agro-Ecological Zone |
| BARI | = | Bangladesh Agricultural Research Institute |
| BADC | = | Bangladesh Agricultural Development Corporation |
| cm | = | Centimeter |
| cv. | = | Cultivar |
| CV% | = | Percentage of coefficient of variance |
| DAS | = | Days after sowing |
| ˚C | = | Degree Celsius |
| *et al.* | = | And others |
| G | = | Gypsum |
| g | = | Gram |
| HI | = | Harvest Index |
| $ha^{-1}$ | = | Per hectare |
| Hr | = | Hour |
| kg | = | Kilogram |
| LSD | = | Least Significant Difference |
| MP | = | Muriate of Potash |
| mm | = | Millimeter |
| Max | = | Maximum |

| | | |
|---|---|---|
| Min | = | Minimum |
| NPK | = | Nitrogen, Phosphorus and Potassium |
| NS | = | Non significant |
| No. | = | Number |
| ppm | = | Parts per million |
| % | = | Percent |
| SRDI | = | Soil Resources and Development Institute |
| SAU | = | Sher-e-Bangla Agricultural University |
| TSP | = | Triple Super Phosphate |
| T | = | Ton |
| viz. | = | Videlicet (namely) |
| Wt. | = | Weight |

# CHAPTER-I

# INTRODUCTION

Sesame (*Sesamum indicum* L.), is an erect annual herb. It is a crop under pedaliaceae family. It is commonly known under different names in different countries such as- simsim, benniseed and til. It is one of the oldest and most traditional oilseed crops, valued for its high quality seed oil. It is cultivated in both tropical and sub-tropical regions of Africa, Asia and Latin America. Sesame is the most important crop from which semi drying vegetable oils are obtained and perhaps the oldest crop cultivated for its oil. Sesame was the main oil crop grown by the Indus Valley Civilization and was likely transferred to Mesopotamia around 2500 B.C. World total cultivation area was 9,398,770 ha, producing 4.76 million tons, which has risen from 1.12 million tons in the early 1961s. About 70% and 26% of world sesame grow in Asia and Africa. The leading sesame producing countries are Myanmar, India, China, Ethiopia, Sudan, Nigeria, Uganda, Tanzania, Niger and Burkina Faso.

Sesame is a versatile crop with high quality edible oil having different usage. It contains 50% oil and 18-20% protein. Sesame oil is considered to be of high quality oil and is often referred to as the queen of vegetable oil. It contains less amount of eurocic acid and high amount of linoleic acid which is beneficial for human health. Sesame is the second largest source of edible oil in Bangladesh. The oil is odourless, colorless and remains liquid at low temperature. In Japan, it is used as domestic and commercial cooking oil. In Bangladesh and in various parts of Indian subcontinent, sesame seeds are used in sweet making in various forms. Sesame oil is also used as hair oil in Bangladesh. Sesame oil is used in the production of paints, soaps, cosmetics, perfumes, insecticides as well as for pharmaceutical and ethno botanical uses. The whole seed is high in calcium, phosphorus, iron and is well supplied with essential vitamins such as thiamin, riboflavin and niacin.

Sesame oilcake is used as a very good cattle feed since it contains high amount of good quality protein. Sesame seed meal is rich in minerals and contains available fatty acids and amino acids which may be used as a good feed of fish and animal. Sesame oilcake contains 6.2-6.3% N, 2.0-2.1% $P_2O_5$ and 1.1-1.3% $K_2O$. The cake can also be used as manure. Sesame fried seed mixed with sugar or in the form of sweetmeat tiler khaja is a tasty snack in Bangladesh. The seed is also used for decoration on the surface of breads, nimkies, biscuits and cookies is most popular to the Bangladesh.

In Bangladesh, the crop can be cultivated both in Kharif and Rabi seasons but two third of sesame is produced in Kharif season. Faridpur, Panchagar, Khulna, Pabna, Barisal, Comilla, Rajshahi, Jessore, Feni, Rangpur, Sylhet and Mymensingh districts are the leading sesame producing areas of Bangladesh. Sesame can play an important role to fulfill the local demand of edible oil because the climate of our country is suitable for sesame cultivation. It is a short duration and photo insensitive crop with wider adaptability, so it can be cultivated both in rabi and kharif seasons. In Bangladesh, sesame is mainly produced by small holders farmers on relatively poor soil with limited inputs, thereby resulting in low average yield of 500 $kgha^{-1}$ compared with 6200 hectogram $ha^{-1}$(620 $kgha^{-1}$) in Myanmar and 12000 hectogram $ha^{-1}$ (1200 $kgha^{-1}$) in China respectively. The main reasons behind of this low yield are lack of high yielding varieties, lack of production inputs, improper management practices etc. Management practices are proper and judicious application of inorganic fertilizers, irrigation, intercultural operations etc. They have significant positive effect on sesame yield especially fertilizer application.

Fertilizer both organic and inorganic play a significant role in case of higher yield of saseme. Organic fertilizers such as urea, TSP, SSP, MOP, DAP, MAP etc and inorganic fertilizers such as cowdung, compost, vermi-compost, poultry litter, FYM , bone meal etc are used in sesame cultivation . Urea gives higher amount of

N, TSP gives higher amount of $P_2O_5$, MOP gives higher amount of $K_2O$. Nitrogen is one of the important nutrient elements that accelerates the growth of plant. It is also an important element of chlorophyll and takes part in protein synthesis. So nitrogen is essential for developing living tissue in plant and enhances the seed yield. Phosphorus is a key component of ATP and it plays a significant role in the energy transformation in plants. It plays a significant role in seed formation and its quality improvement. An adequate supply of phosphorus is needed during the growing period of sesame for maximizing yield. Potassium is needed for flowering and fruiting on crop. Inorganic fertilizer supplies moderate amount of NPK. The price of organic fertilizer is less than inorganic fertilizer and easily available. Organic fertilizers supply considerable amount of NPK which reduce the use of amount of inorganic fertilizer in crop field. Organic fertilizers improve both soil physical and chemical compositions. It also increase crop quality.

Now-a-days, to increase the yield, excessive dose of inorganic fertilizer is used. Due to excessive use of fertilizer, soil losses its fertility; environment, water and air pollution occurs. Different soil micro-organisms cannot survive in soil. Finally soil health is damaged. Although inorganic fertilizer has number of disadvantages but it is necessary for growth and development of crops. So, it cannot be fully avoided. We can minimize the use of inorganic fertilizer by a good alternative to inorganic fertilizer to protect the soil health and remove different pollution hazards. One solution can be the use of organic fertilizer like cowdung, vermicompost, poultry manure etc. Organic fertilizer improves soil fertility. Organic fertilizers have also been reported to greatly improve water holding capacity, soil aeration, soil structure, nutrient retention and microbial activity.

The yield of sesame is increased by organic fertilizer in the Southern Guinea Savanna of Nigeria. Considering the low yield of sesame obtained in most growing areas and the poor fertility status of soil, the experiment was undertaken to assess the performance of sesame using different combinations of inorganic and organic fertilizers.

Objectives of the research work-

i. To evaluate the effect of different combinations of inorganic and organic fertilizer on the growth of sesame,
ii. To study the effect of different combinations of inorganic and organic fertilizer on the yield attributes and yield performance of sesame, and
iii. To find out the possibility of reducing chemical fertilizers by organic fertilizer.

# CHAPTER-II

# REVIEW AND LITERATURE

Sesame (*Sesamum indicum* L.) is an important oil seed crop grown in tropical and sub-tropical areas. It is grown for the seed which is an excellent source of high quality oils, rich in carbohydrate, calcium, phosphorus and protein. In this chapter, an attempt was made to collect and present relevant information available regarding the influence of inorganic and organic fertilizers and their different combinations in sesame to get knowledge helpful in conducting the present research work.

## 2.1 Performance of organic fertililizers

Attarde *et al.* (2012) conducted an experiment to investigate the effect of organic and inorganic fertilizers on growth and nutrient status of *Abelmoschus esculentus* (okra plant). For the experiment, various combinations of fertilizers such as Vermicompost (VC), Chemical Fertilizer (CF) and Farmyard Manure (FYM) were applied by followings, $T_1$: Control, $T_2$: (FYM 100%), $T_3$: (VC 100%), $T_4$: (CF 100%), $T_5$: (VC 75% + CF 25%), $T_6$: (VC 75% + FYM 25%), $T_7$: (VC 50% + FYM 50%) and $T_8$: (VC 50% + CF 50%). The study indicated that with the use of inorganic fertilizers plants physical characteristics were enhanced compared to other treatments whereas nutrient status of okra fruit was recorded maximum in treatment $T_3$ (VC 100%) and followed by $T_6$ (VC 75% + FYM 25%).

Daniel and Jader (2012) reported that use of vermicompost and its product represents a crucial ecofriendly technology that capable of recycling organic wastes to be used as fertilizers. Through its hormone-like substances vermicompost, liquid humus or worm bed leachates stimulates plant growth.

Jayakumar and Natarajan (2012) conducted an experiment and find out that vermicomposting is a non-thermophilic, boioxidative process that involves earthworms and associated microbes. Vermicompost enhances soil biodiversity by promoting beneficial microbes which in turn enhance plant growth directly by production of plant growth-regulating hormones and enzymes and indirectly by controlling plant pathogens, nematodes and other pests thereby enhancing plant health and minimizing the yield loss.

Nath and Singh (2012) used of vermiwash extracted from vermicomposts as liquid biofertilizer for growth and productivity of paddy (*Oryza sativa*), maize (*Zea mays*) and millet (*Penisetum typhoides*) crops and noticed significant effect on growth and productivity.

Vanmathi and Selvakumari (2012) conducted an experiment on *Hibiscus esculentus* and allowed to grow in the medium of vermicompost and urea to examine the effect of vermicompost and urea on the growth and yield. There were 3 treatments viz., control, vermicompost ($T_1$) and urea ($T_2$). From the study, maximum plant height (19.8cm), number of flower (21.3), number of fruit (15.0), fruit weight (10.3g), total fruit weight (185.0g) and fruit length (12.3cm) was found from the application of vermicompost on *Hibiscus esculentus*.

Amir and Ishaq (2011) reported the importance of composts as a source of humus and nutrients to increase the growth of plant. Different composts (Vermicompost and Pitcompost) and garden soil (Control) were taken for the chemical analysis firstly and then to find the effect of these composts on the growth of a vegetative crop '*Pisum sativum'*. From the chemical analysis it was found that vermicompost was rich in nutrients like potassium, nitrate, Sodium, calcium, magnesium and chloride and have the potential for improving plant growth than pit compost and garden soil (control).

Cristina and Jorge (2011) reported that vermicompost can be described as a complex mixture of earthworm faeces, humified organic matter and microorganisms that when added to the soil or plant growing media, increases germination, growth, flowering, fruit production and accelerates the development of a wide range of plant species. The enhanced plant growth may be attributed to biologically mediated mechanisms such as the supply of plant-growth regulating substances and improvements in soil biological functions. Stimulation of plant growth may depend mainly on biological characteristics of vermicompost, plant species used and cultivation conditions.

Haruna and Abimiku (2012) conducted experiments during the rainy seasons of 2008 and 2009 at the teaching and research farm of Nasarawa State University, Keffi, Lafia campus in the southern Guinea savanna agro ecological zone of Nigeria to assess the effects of poultry manure, cow manure and sheep manure on the growth of sesame crop. Manure application was found to have significantly increased both yield and yield attributes of sesame compared with non application at all. Application of 2.5 t/ha of poultry manure produced the highest value for all the yield attributes measured. The seed yield per hectare in both years were also optimized with the application of 2.5 t/ha of poultry manure (1914.07 and 1933.20 kg/ha in 2008 and 2009 respectively) compared with any other applied rates of sheep and cow manure.

Ogbonna and Umar-Shaba (2012) conducted an experiment in the research farm of the Department of Crop Science, University of Nigeria, Nsukka, to test the effects of accessions and poultry manure rates on the growth and yield of sesame in the derived savannah zone of south eastern Nigeria. Three rates of poultry manure (0, 5 and 10 tons/ha) and four accessions of sesame (Zuru, NCRI-BEN O1M, 43–9–1 and NCRI-BEN O3L) were tested. The experiment was laid out in a 3×4 factorial experiment in randomized complete block design in three replications. The result showed that the application of poultry manure significantly promoted sesame growth and yield.

Akande *et al.* (2011) noted that large population of micro organisms are introduced to the soil through organic manure which promoted N fixation and P solubilization. All these contributed to the enhancing effect on growth and yield attributes obtained from the poultry manure application.

Haruna (2011) observed that 10 tons/ha poultry manure application produced the highest grain yield as further increase to 15 tons/ha resulted to a decline in grain yield in sesame.

Tharmaraj *et al.* (2011) narrated that vermicompost treated plants exhibit faster and higher growth rate with maximum number of leaves, height, leaf length and productivity.

Joshi and Vig (2010) reported that various growth, yield and quality parameters like mean stem diameter, plant height, yield/plant, leaf number, total plant biomass, ascorbic acid, titrable acidity, soluble solids, insoluble solids and pH were increased significantly when treated with vermicompost.

Sinha *et al.* (2010) reported that vermicompost is a very important biofertilizer produced through the artificial cultivation of worms i.e., vermiculture. Vermicompost is enriched with all beneficial soil bacteria and also contain many of the essential plant nutrients like N, P, K and micronutrients. It increases soil aeration and texture. Plant grown in vermicompost pretreated soil represents maximum increase in all morphological parameters such as root length, shoot length, number of root branches, number of stem branches, number of leaves, number of flowers, number of pods and number of root nodules in four months sampling in comparison to untreated, FYM treated and DAP treated soils in *Pisum sp.* and *Cicer sp.*

Farhad *et al*. (2009) observed that poultry manure has long been recognized as the most desirable organic fertilizer. It improves soil fertility by adding both major and essential nutrients as well as soil organic matter which improve moisture and nutrient retention of soil.

Pornparn *et al*. (2009) reported that yield obtained by the use of organic manures in sesame production compare favourable with that grown with inorganic fertilizer with the extra benefit of improving the soil pH, organic matter, phosphorus, potassium, minor elements and high microbial biomass carbon.

Peyvast *et al.* (2008) found the effects of different amounts of vermicompost to soil on growth, yield and chemical characteristics of spinach (*Spinacia oleracea* L.) cultivar "Virofly" were investigated in an unheated greenhouse. The results indicated that an addition of vermicompost to soil can increase number of leaves significantly.

Anon (2007a) reported that organic manure has also been found to be greatly improved water holding capacity, soil aeration, soil structure, nutrient retention and microbial activity

Anon (2006) found that manure application results in increased pH, water holding capacity and decrease in bulk density when used on long term basis.

Barik *et al.* (2006) found that vermicompost is the earthworm derived organic fertilizers that not only supplies a good amount of different nutrient elements but also contains beneficial microbes like nitrogen fixing bacteria, mycorrhizae and growth promoting substances for betterment of crops.

Hidlago *et al.* (2006) reported that the incorporation of earthworm increased plant growth, leaf growth and root length. The suitability of vermicompost amended soil for sustaining plant growth and biological activity is a function of physical properties and the chemical properties which depend on soil organic matter.

Kannan *et al.* (2006) reported that application of recommended quantities of vermicompost to different field crops has been reported to reduce the requirement of chemical fertilizers without affecting the crop yield. Application of 100% nitrogen as vermicompost registered the higher plant height and number of branches per plant of tomato and it was significantly superior over supplementation of 100% N through urea and FYM.

Chaoui *et al.* (2005) made a report that vermicompost has been shown to have high levels of total and available nitrogen, phosphorous, potassium (NPK) and micro nutrients, microbial and enzyme activities and growth regulators.

Edwards *et al.* (2004) reported that vermicompost have fine particulate structure, low C: N ratio, with organic matter oxidized, stabilized and converted into humic materials. It contains nutrients transformed into plant available forms and are extremely microbially-active. Addition of low rate of substitution of vermicompost on plant growth media to field crops have consistently increases plant germination, growth, flowering, fruiting, independent of nutrient availability.

RMRDC (2004) and FAO (2002) reported that sesame oil is considered to be of high quality oil and is often referred to as the "queen" of vegetable oil. This is due to its stability and high keeping quality as well as resistance to rancidity. Sesame oil is used in the production of paints, soaps, cosmetics, perfumes, insecticides, canned sardine and canned beef as well as for pharmaceutical and ethno botanical uses

Aliyu (2003) found that poultry manure could be attributed to the low nutrient status of the soil and the ability of manures to supply nutrients contained in them gradually to support crop growth which later translated to high yield and yield attributes

Gupta (2003) reported that vermicompost has been emerging as an important source in supplementing chemical fertilizers in agriculture in view of sustainable development. It is a biofertilizer enriched with all beneficial soil microbes and also contains all the essential plant nutrients like N, P and K.

Parthasarthi and Ranganathan (2002) found that vermicomposting is a bio-oxidation and stabilization process of organic material that involves the joint action of earthworms and microorganisms. The earthworms are the agents of turning, fragmentation and aeration. It also increase $N_2$ fixation by both nodular and free living $N_2$ fixing bacteria and thus enhance plant growth. Vermicompost has been proved as cheapest source of nitrogen and other essential elements for better nodulation and yield particularly in legumes. Such plants can meet their nitrogen needs through both biological nitrogen fixation (symbiosis) and native nitrogen in the soil.

Ali and Jahan (2001) reported that vermicompost is non toxic, utilize low energy input for composting and recycled bioorganic product. Due to absence of toxic enzymes it is also ecofriendly and has beneficial effect on the biochemical activities of the soil.

Mbagwu and Ekwealor (1990) reported that the enhancing effect of poultry manure is attributed to the release of nutrient to the soil as well as improving the soil physical properties to the benefit of the crop.

Abdel-Sabour and Abo (1996) investigated the agronomic aspects of some organic waste compost applications to sesame plants grown on sandy soil. Different rates and combinations from biosolids (BS), municipal solid waste (MSW) and water hyacinth (W) compost, incorporated with or without shale deposits (tafla) at 8%, were used to treat the sandy soil. Dry matter accumulation was used as an indicator of the effectiveness of such treatments on plant growth. In addition, the contents of nitrogen-phosphorus-potassium, chlorophyll, total protein, oil and carbohydrates were determined in plant tissue as physiological parameters. Heavy metal contents (Fe, Mn, Zn, Cu, Co, Ni, Cd, Pb) in seeds samples were determined. Results indicated that all compost treatments stimulated sesame growth and enhanced its pigment, carbohydrate and mineral contents.

Kroodsma (1986) found that manure also provides a gradual and more lasting release of a wide range of nutrient elements to the soil.

## 2.2 Performance of inorganic fertilizers

Bikram *et al*. (2014) conducted an experiment to find out the effect of nitrogen (N) levels (0, 20, 40, 60 and 80 kg/ha) each applied in two equal splits viz., 1/2 as basal+1/2 at 30 days after sowing (DAS) and morphological modification through nipping of terminal bud by hand clipping (without nipping; and nipping at 25, 30 and 35 days crop stage) on the productivity of sesame (*Sesamum indicum* L.) under irrigated conditions during kharif 2005 and 2007. The pooled mean results of the investigation revealed that application of 40 kg N/ha in two equal splits viz., 1/2 N as basal+1/2 N at 30 DAS along with nipping of terminal bud by hand clipping at 30 days crop stage in sesame proved superior in respect of seed yield (4.46 q/ha) and fetched maximum net returns (Rs. 8359/ha) and benefit: cost ratio (1.79) over all other treatment combinations.

Patel *et al.* (2014) conducted an experiment on response of summer sesame (*Sesamum indicum* L.) to different spacing and levels of nitrogen. Application of nitrogen @ 75 kg/ha recorded significantly higher seed (630 kg ha-1) and stalk yields (2119 kg /ha) over 0, 25 and 50 kg N/ ha and significantly improved growth and yield attributing characters viz., plant height, number of branches/ plant, dry matter production /plant, number of capsules/ plant, seed yield /plant and 1000 seed weight. Application of nitrogen @ 75 kg/ha significantly improved N, P and K content (seeds and stalk) and uptake (seeds, stalk and total). Treatment combination 60 cm spacing and 75 kg N/ ha bearing maximum values of all these parameters ranked at top.

Shahzad and Amanullah (2014) conducted an experiment to study the performance of sesame cultivars (*Sesamum indicum* L.) using various sowing dates and nitrogen levels at New Developmental Farm The University of Agriculture, Peshawar, Pakistan during summer 2012. The experiment was laid out in (RCBD) with split plot arrangement having four replications. Sowing dates (20th June, 10th and 30th July) and sesame cultivars (local black and local white) were allotted to main plots, while nitrogen levels (0, 40, 80 and 120 kg N/ha) were allotted to sub plots. Nitrogen application had significantly affected all parameters. Plots treated with 120 kg N/ha produced maximum capsules /$m^2$ (951), capsules/plant (86), seed /capsule (70), shelling percentage (70%), 1000 seed weight (4.08 g), seed yield (833 kg /ha), stover yield (5351 kg /ha) and harvest index (15%). The interaction between sowing dates, nitrogen level and sesame cultivars showed that crop sown on 20th June with local black cultivar and treated with 120 kg N /ha had maximum capsules /plant (128), seed /capsule (82), seed yield (1599 kg/ ha) and stover yield (9223 kg /ha).

Stanley and Basavarajappa (2014) conducted a field experiments in Karnataka, India, during the 2012 kharif season, to determine the effect of nutrient management on growth and yield of sesame cv. DS-5 100% N as basal. The treatments comprised 100% nitrogen (N) fertilizer as basal application (T1), 50% N as basal + 50 % N at 30 days after sowing (DAS; T2), T1 + 1.5% urea foliar spray at flower initiation stage (FIS; T3), T1 + 1.5% urea foliar spray at capsule initiation stage (CIS; T4), T1 + 1.5% urea foliar spray at FIS and CIS (T5), T1 + DAP at 1.5% foliar spray at FIS (T6), T1 + DAP at 1.5% foliar spray at CIS (T7), T1 + DAP at 1.5% foliar spray at FIS and CIS (T8), T2 + 1.5% urea foliar spray at FIS (T9), T2 + 1.5% urea foliar spray at CIS (T10), T2 + 1.5% urea foliar spray at FIS and CIS (T11), T2 + DAP at 1.5% foliar spray at FIS (T12), T2 + DAP at 1.5% foliar spray at CIS (T13) and T2 + DAP at 1.5% foliar spray at FIS and CIS (T14). Data on the yield and its components, plant height and number of branches per plant were recorded. Results showed that the overall improvement in yield and yield components of sesame was obtained with N in 2 equal splits and DAP at 1.5% foliar spray at flower initiation stage and second at capsule initiation stage over the recommended dose of fertilizer.

Bhosale *et al.* (2011) conducted an experiment to study the response of sesame (*Sesamum indicum* L.) to different levels of potash and sulphur under south saurashtra region. Result of the experiment revealed that an application of potash @ 50 kg/ ha recorded significantly higher yield attributes and yield, quality parameters, nutrient uptake by seed and economics i.e. number of capsules per plant (39.17), length of capsule (2.30 cm), number of seeds per capsule (57.13), seed weight per plant (3.94 g), test weight (2.96 g) Seed yield (813 kg ha-1) and Stover (1165 kg /ha). Similarly sulphur application @ 40 kg /ha recorded significant effect in increasing all these yield attributes and yield, quality parameters, nutrient uptake by seed and economics of sesame.

Ali *et al*. (2010) found that addition of N and P fertilizer enhances root development, which improves the supply of other nutrients and water to the growing parts of the plants, resulting in an increased photosynthetic area and thereby more dry matter accumulation.

Okpara *et al*. (2007) reported that significant increase in plant height, number of branches per plant leaf area index, crop growth rate total dry matter and grain yield per unit area due to nitrogen and phosphorus application.

Haruna *et al*. (2010) found that grain yield per hectare of sesame was optimized at moderate rates of applied poultry manure (5 t/ha) and nitrogen (60 kg N/ha) and not the highest applied rates as in growth indices. This could be because excessive manure and nitrogen application has been reported to reduce fruit number and yield but enhanced plant growth.

Anonymous (2006) reported that leaf area index at 6, 8, and 10WAS in all years was significantly increased by poultry manure and nitrogen application up to 15 t/ ha and 120 kg N/ha respectively. This could be attributed to increase in mineralized nutrients in manure which improved soil physical and chemical conditions and improved availability of both micro and macro nutrients, and nitrogen that were necessary for the formation of chlorophyll, efficient rooting system and production of biomass

Pathak *et al.* (2002) conducted an experiment in the Barak Valley Zone of Assam, India, to evaluate the effect of N levels (0, 15, 30 and 45 kg/ha) on the growth and yield of sesame (*S. indicum*). N at 45 kg/ha recorded the highest mean values for plant height (74.3 cm), number of branches per plant (4.50), number of capsules per plant (39.0) and 1000-grain weight (2.91 g). N at 45 kg/ha also recorded the highest values for seed yield (6.95 and 7.25 q/ha), net return (Rs. 4450 and 4700/ha) and benefit cost ratio (1.78 and 1.84) during 1997 and 1998, respectively.

Imayavaramban *et al.* (2002) conducted a field experiments to find out the effect of varied plant populations and nitrogen rates with or without Azospirillum inoculation on the productivity and economic returns in sesame cv. VRI 1. The highest plant population of 166 666/ha significantly recorded the maximum seed yield, net income and the benefit cost ratio compared to lesser plant population viz., 133 333 and 111 plants /ha. Similarly, application of an extra 25% of nitrogen than the recommended in combination with seed inoculation with Azospirillum significantly recorded the maximum seed, net income, and benefit cost ratio during both the cropping seasons.

### 2.3 Combined effect of organic and inorganic fertilizers

Savita *et al.* (2014) conducted an experiment to compare the nutritional composition of wheat, chickpea and sesame seed grown under organic and inorganic conditions. The data were statistically analyzed for completely randomized design (CRD) and 't' value using standard methods. Inorganically grown wheat, chickpea and sesame seed had significantly ($P<0.05$) higher protein, crude fibre, phytic acid, polyphenol and trypsin inhibitor activity than that of organically grown wheat, chickpea and sesame seed. However, organically grown crops contained significantly (P<0.05) higher fat and ash content than the inorganic ones. As a result, the protein and starch digestibility (in vitro) were significantly (P<0.05) higher in wheat, chickpea and sesame seed grown under organic conditions. Inorganically grown wheat, chickpea and sesame seed had significantly (P<0.05) more amount of phosphorus and zinc. The HCl extractability of calcium, iron and zinc was significantly (P<0.05) higher in wheat, chickpea and sesame seed grown under organic conditions. It may be concluded from present research that the wheat, chickpea and sesame seed grown under organic condition had lower anti-nutritional factor and therefore higher digestibility of starch, protein and minerals.

Ghosh *et al.* (2013) were carried out a field experiments to study the effect of nutrient management in summer sesame and its residual effect on succeeding kharif black gram during 2003 and 2004 in sub-humid lateritic tract of West Bengal. The crop growth was better with integrated application of 50% recommended dose of NPK through fertilizer (RDF), 50% N through vermicompost (VC) or FYM along with Azospirillum in sesame. The number of capsules plant-1, seeds capsule-1, seed and oil yield of sesame increased significantly due to integrated application of 50% RDF+50% N through FYM along with Azospirillum in sesame during both the years. However, the treatment was at par with those of 75% RDF+25% N through FYM or VC along with Azospirillum and 50% RDF+50% N through VC along with Azospirillum. Integrated use of fertilizer, organic manure and Azospirillum produced higher seed and oil yield of sesame compared to 100% RDF through fertilizer alone.

Banik and Kajal (2013) conducted a field experiment to find out the best nutrient management for mungbean and its residual effect on succeeding crop. Application of N, P and K along with sulphur and farm compost increased the yield of mungbean. Highest grain yield was obtained from treatment including single superphosphate (SSP) followed by phospho-gypsum @ 30 kg S/ha along with recommended dose of N, P and K. Treatments receiving different doses of farm compost gave satisfactory yield in increasing trend in terms of grain yield. The response to residual nutrients on seed yield of linseed (*Linum usitatissimum* L.) or sesame (*Sesamum indicum* L.) was positive and significant.

Singh *et al.* (2013) conducted an experiment to evaluate lower doses of FYM (2, 4 and 6 tonnes FYM/ha) in combination with three NPK levels (180:34.9:100, 270:52.4:150 and 360:69.8:200 kg/ha) for potato at CPR1 Station, Gwalior, Madhya Pradesh. Sesame was grown on residual fertility in sequence. Integrated use of NPK 270:52.4:150 kg/ha along with 2 tonnes of FYM/ha recorded highest benefit cost ratio (2.2). Increasing application of NPK (180:34.9:100 to 270:52.4:150 kg/ha) increased large-sized tuber yield (7.5-8.5 tonnes/ha) and total tuber yield (28.4-32.4 tonnes/ha), however application of 2,4 or 6 tonnes FYM/ha did not show any significant increase in total tuber yield. Increasing NPK levels increased potato equivalent yield from 32.2 to 37.3 tonnes/ha.

# CHAPTER-III

# MATERIALS AND METHODS

The experiment was conducted during the period from mid March to mid June 2015 at the Agricultural Farm, Sher-e-Bangla Agricultural University, Dhaka. The experiment was designed to study the influence of different combination of inorganic and organic fertilizer in sesame. The materials and methods followed in this experiment are presented in this chapter under the following headlines-

## 3.1 Description of the experimental site

### 3.1.1 Site and soil

The experiment was carried out at the Field, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, dhaka-1207 that lies between $90^0$ 22 longitude and $23^0$ 41 N latitude at an altitude of 8.6 meters above the sea level. The land under the Agro-ecological zone of Madhupur Tract (AEZ 28) of Tejgaon soil series. The topography is high and the soil texture is silty clay loam. The pH of the soil is 6.8. The chemical and physical compositions of the experimental soil have been presented in Appendix II(B).

### 3.1.2 Climate and weather

The climate of this area is sub tropical. High temperature and heavy rainfall during Kharif season (March-September) and scanty rainfall in rabi season is the characteristics of this climate.

## 3.2 Experimental treatments

$T_0$ = Control

$T_1$ = Chemical fertilizer ( Fertilizer at Recommended Dose)

$T_2$ = Mixed fertilizer

$T_3$ = Cowdung + 25% FRD

$T_4$ = Vermicompost + 25% FRD

$T_5$ = Poultry manure + 25% FRD

$T_6$ = Cowdung + 50% FRD

$T_7$ = Vermicompost + 50% FRD

$T_8$ = Poultry manure +50% FRD

$T_9$ = Cowdung + 75% FRD

$T_{10}$ = Vermicompost + 75% FRD

$T_{11}$ = Poultry manure +75% FRD

FRD = Fertilizer at Recommended Dose

Recommended dose of chemical fertilizer has been presented in below-

N = 46 kg $ha^{-1}$

P = 26 kg $ha^{-1}$

K = 25 kg $ha^{-1}$

S = 18 kg $ha^{-1}$

Zn = 1.80 kg $ha^{-1}$

B = 1.70 kg $ha^{-1}$

## 3.3 Planting materials

The variety was used as the test crop is BARI Til-4. The seeds of this variety were collected from the Oil Seed Division of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. A recommended variety of sesame is BARI Til-4, which was developed by the national seed board. It cultivates both in kharif and rabi season.

The salient features of the variety are :

1. Plant height is 90-120 cm
2. Leaves are deep green and uneven
3. Seeds are livery colors
4. Flowers are light rosy colors
5. Life cycle is 90-95 days
6. Capsule plant$^{-1}$ are 85-90
7. Seeds capsule$^{-1}$ are 75-77
8. Average yield is 1250-1500 kg ha$^{-1}$

### 3.4 Experimental design and layout

The experiment was designed in a Randomized Complete Block Design (RCBD) with three replication. The size of each plot area was 4m × 1.5m. The adjacent blocks and adjacent plots were separated from one another by 1 m and 0.5 m.

### 3.5 Land preparation

The experimental land was ploughed three times using a power tiller followed by laddering to obtain the desirable tilth. All uprooted weeds, stubble and residues are removed from the land. Trimming ails are also done.

### 3.6 Fertilizer application

Cowdung, Vermicompost, Poultry manure, Urea, Triple super phosphate, Potash, Gypsum, Zinc sulphate, Boric acid and Mixed fertilizer were applied at the rate of 10 t, 1.5 t, 10 t, 100 kg, 130 kg, 50 kg, 100 kg, 5 kg, 10 kg and 250 kg ha$^{-1}$as per treatment. Half of Urea and all other fertilizers were applied during final land preparation. The rest amount of urea was applied as top dressing after 30 days of sowing.

### 3.7 Seed rate and sowing

Seeds were sown on 5th March 2015 at the rate of 7.5 kg $ha^{-1}$. Before sowing on the field seeds were treated with vitavex-200 at the rate of 2.5 g $kg^{-1}$of seeds. Row to row distance was 30 cm. Plant to plant distance was 5 cm which was maintained by thinning plants. Small furrows of approximately 5 cm depth were made by hand rake. After sowing seed on furrow , seeds were covered with soil by hand.

### 3.8 Intercultural operations

#### 3.8.1 Weeding and thinning

Two times weeding were done in the field manually. First weeding was done after 15 days of sowing and second weeding was done before flowering at 30 DAS . Thinning was done at15 DAS for proper growth and development of crop.

#### 3.8.2 Irrigation and drainage

For good seed germination, pre-sowing irrigation was done in preparing land before one week of seed sowing. First irrigation was given after 30 days of sowing before flowering and second irrigation was given after 60 days of sowing during capsule formation. Excess water was removed from the field by making drain.

#### 3.8.3 Pest management

Diazinon 60 EC was applied at the rate of 2 ml $L^{-1}$ to control hawk moth on 50 DAS.

### 3.9 Harvesting and sampling

The crop was harvested plot wise on 7 July 2015 when about 80% of the capsules became mature. Growth data on plant height, number of branches $plant^{-1}$, dry matter weight $plant^{-1}$ were collected from five selected plants in each plot. Plants of one meter square were collected for taking yield data from each plot. Before harvesting ten plants were selected randomly from each plot. After harvesting, the plants were bundled, tagged and brought to the threshing floor. Then the bundles were dried in sun.

### 3.10 Threshing, drying, cleaning and weighing

After harvesting, the plants were brought to the threshing floor. After drying, threshing was done by beating with sticks. The seeds were collected. Collected seeds were dried in the sun for reducing moisture. Dried seeds and straw were cleaned and weighed.

### 3.11 Collection of data

The following growth, yield contributing character and yield data were collected in this experiment-

1. Plant height (cm)
2. Number of branches plant$^{-1}$
3. Dry matter weight plant$^{-1}$
4. Number of capsules plant$^{-1}$
5. Number of seeds capsule$^{-1}$
6. 1000 seed weight (g)
7. Seed yield (Kg ha$^{-1}$)
8. Stover yield (Kg ha$^{-1}$)
9. Biological yield (kg ha$^{-1}$)
10. Harvest index(%)

### 3.12 Outline of the data recording

A brief outline of the data recording is given below-

### 3.12.1 Plant height (cm)

Plant height was measured from five pre selected plants in each plot at 30, 45, 60, 75 DAS and at harvest. The height was measured from the base to the tip of each plant and averaged then to have height plant$^{-1}$.

### 3.12.2 Number of branches plant$^{-1}$

Number of branches of pre-selected 5 plants was taken and branches of individual plant were then calculated. The number of branches plant$^{-1}$ was taken at 45, 60, 75 DAS and at harvest.

### 3.12.3 Dry matter weight plant$^{-1}$

Five plants were collected randomly from each plot at 30, 45, 60, 75 DAS and at harvest. The sample plants were oven dried for 72 hours at 70˚c and then dry weight plant$^{-1}$ was determined.

### 3.12.4 Number of capsules plant$^{-1}$

Total number of capsules was collected from 10 randomly selected plants from each treatment and then the number of capsule per plant was calculated.

### 3.12.5 Number of seeds capsule$^{-1}$

Number of seeds capsule$^{-1}$ was counted from the randomly selected 20 capsules on each plot and then the average number of seed was calculated per capsule basis.

### 3.12.6 Weight of 1000 grain (g)

1000 seeds were counted by hand from the seeds of each plot and weighed in electric balance at 8% moisture level.

### 3.12.7 Seed yield (kg ha$^{-1}$)

The crop of 1 $m^2$ area was harvested at full maturity. Seeds were threshed out from the capsule, cleaned and dried in the sun to bring them in safe moisture content. Then seeds were weighed and converted to yield as kg ha$^{-1}$.

### 3.12.8 Stover yield (kg ha$^{-1}$)

After separating the seeds from the crop of 1 $m^2$ area, the stover was dried in the sun, weighed and stover yield was recorded in terms of kg ha$^{-1}$.

### 3.12.9 Biological yield (kg ha$^{-1}$)

The summation of seed yield and stover yield per hectare was the biological yield.

$$\text{Biological yield (kg ha}^{-1}\text{)} = \text{Seed yield (kg ha}^{-1}\text{)} + \text{Stover yield (kg ha}^{-1}\text{)}$$

### 3.12.10 Harvest index (%)

Harvest index was calculated by the following formula-

$$\text{Harvest index (\%)} = \text{Grain yield (kg ha}^{-1}\text{)} / \text{Biological yield (kg ha}^{-1}\text{)} \times 100$$

## 3.13 Statistical analysis

All the collected data were analyzed following the analysis of variance (ANOVA) technique and the mean differences were compared by Least Significant Difference (LSD) using a computer operated programme named Statistix 10.

# CHAPTER-IV

# RESULTS AND DISCUSSION

The result of this experiment have been presented and discussed with the help of tables and possible interpretations given under the following headings-

## 4.1 Plant height

The plant height was recorded at different stages of plant growth and development i.e. 30 DAS, 45 DAS, 60 DAS, 75 DAS and at harvest. Plant height of sesame was significantly influenced by different combinations of organic and inorganic fertilizers (Table 1). At 30 DAS, poultry manure + 75% FRD showed the tallest plant height (45.97 cm) and it was significantly highest than other treatments. Chemical fertilizer showed the second tallest plant (42.65 cm) which was statistically similar to vermicompost + 75% FRD, mixed fertilizer, cowdung + 75% FRD. These treatments showed plant height of 41.83 cm, 41.17 cm and 39.74 cm, respectively. Control showed the shortest plant (32.26 cm) which was statistically similar with cowdung + 25% FRD, vermicompost + 25% FRD that showed plant height 33.77 cm and 34.91 cm, respectively.

At 45 DAS, plant height obtained from poultry manure + 75% FRD showed the tallest plant which was 88.04 cm. This plant height was statistically similar to vermicompost + 75% FRD, chemical fertilizer, cowdung + 75% FRD, poultry manure + 50% FRD, vermicompost + 50% FRD and mixed fertilizer that were 87.52 cm, 86.33 cm, 85.37 cm, 84.58 cm, 83.73 cm and 83.03 cm, respectively. Control treatment showed the shortest plant (64.26 cm) which was ststistically similar to cowdung + 25% FRD (68.35 cm).

Plant height increased gradually at 60 DAS than earlier dates 30 and 45 DAS. Chemical fertilizer showed the tallest plant height (109.33 cm). This plant height was statistically similar to vermicompost + 75 % FRD, poultry manure + 75 % FRD that was 108.38 cm and 107.17 cm, respectively. The shortest plant

(80.28 cm) was given by control treatment and that was statistically similar to cowdung + 25 %FRD (84.33 cm).

At 75 DAS, the tallest plant (113.87 cm) was observed by poultry manure + 75% FRD which was statistically similar to chemical fertilizer, vermicompost +75% FRD and cowdung + 75% FRD treatments (113.84 cm, 112.86 cm,108.76 cm, respectively). The shortest value was observed by control treatment (83.17 cm) which was statistically similar to cowdung + 25% FRD (88.67 cm). The result corroborates with the findings of Ogbonna and Umar-Shaba (2012) who reported that poultry manure significantly promoted the sesame growth and yield.

Table 1 indicated that the tallest plant was found by chemical fertilizer applied treatment (111.78 cm) at harvest which was statistically similar to the combination treatment of poultry manure + 75% FRD (110.85 cm), vermicompost + 75% FRD (110.16 cm), cowdung + 75% FRD (107.38 cm) and poultry manure + 50% FRD (105.87 cm). The shortest plant was found by control treatment (81.85 cm) which was statistically similar to cowdung + 25% FRD (86.13 cm) treatment.

**Table 1. Effect of different combination of inorganic and organic fertilizers on plant height of sesame**

| Treatments | Plant height (cm) at different days after sowing (DAS) | | | | |
|---|---|---|---|---|---|
| | **30** | **45** | **60** | **75** | **At harvest** |
| Control | 32.26 i | 64.26 d | 80.28 g | 83.17 e | 81.85 f |
| Chemical fertilizer (FRD) | 42.65 b | 86.33 a | 109.33 a | 113.84 a | 111.78 a |
| Mixed fertilizer | 41.17 b-d | 83.03 ab | 98.47 cd | 105.47 b | 104.32 bc |
| Cowdung + 25% FRD | 33.77 hi | 68.35 d | 84.33 fg | 88.67 e | 86.13 f |
| Vermicompost + 25% FRD | 34.91 g-i | 75.17 c | 89.87 ef | 95.38 d | 93.65 e |
| Poultry manure + 25% FRD | 36.57 e-g | 78.36 bc | 92.65 de | 98.66 cd | 96.18 de |
| Cowdung + 50% FRD | 35.52 f-h | 76.28 c | 90.76 e | 96.30 d | 94.15 e |
| Vermicompost + 50% FRD | 38.86 c-e | 83.73 a | 99.83 c | 104.79 bc | 102.53 cd |
| Poultry manure + 50% FRD | 38.31 d-f | 84.58 a | 100.74 c | 106.35 b | 105.87 ab |
| Cowdung + 75% FRD | 39.74 b-d | 85.37 a | 102.85 bc | 108.76 ab | 107.38 ab |
| Vermicompost + 75% FRD | 41.83 bc | 87.52 a | 108.38 ab | 112.86 a | 110.16 ab |
| Poultry manure + 75% FRD | 45.97 a | 88.04 a | 107.17 ab | 113.87 a | 110.85 a |
| $LSD_{(0.05)}$ | **2.99** | **5.12** | **6.03** | **6.26** | **6.43** |
| CV(%) | **7.93** | **6.54** | **6.37** | **6.25** | **6.55** |

* FRD = Fertilizer at Recommended Dose

## 4.2 Number of primary branches plant$^{-1}$

The number of primary branches plant$^{-1}$ was recorded at different stages of plant growth and development i.e. 45 DAS, 60 DAS, 75 DAS and at harvest. Number of primary branches plant$^{-1}$ was significantly affected by different combinations of organic and inorganic fertilizers. The table 2 showed that vermicompost + 75% FRD gave the maximum number of primary branches plant$^{-1}$ at 45 DAS and that was 7.92. This value was statistically similar to chemical fertilizer and poultry manure + 75% FRD which were 7.70 and 7.50, respectively. Cowdung +25 % FRD gave the minimum number of primary branches plant$^{-1}$ (4.41) which was statistically similar to control treatment (4.42). Other treatments gave the intermediate value of number of primary branches plant$^{-1}$.

At 60 DAS, vermicompost + 75 % FRD showed the maximum number of primary branches plant$^{-1}$ (8.85) which was statistically similar to poultry manure +75% FRD and chemical fertilizer (8.58 and 8.40, respectively). On the other hand, control showed the minimum number of primary branches plant$^{-1}$ (4.95) which was statistically similar to cowdung + 25% FRD (5.32).

It was found that significantly highest value (8.58) of number of primary branches plant$^{-1}$ was recorded with poultry manure + 75% FRD treatment. Vermicompost + 75% FRD showed the second maximum no of primary branches plant$^{-1}$ (7.92) and chemical fertilizer showed the third maximum no of primary branches plant$^{-1}$ (7.17). Poultry manure + 50% FRD showed the fourth maximum no of primary branches plant$^{-1}$ (6.32) which was statistically similar to cowdung + 75% FRD (6.10) and vermicompost + 50% FRD (6.07). Cowdung + 25% FRD showed the minimum number of primary branches plant$^{-1}$ (4.57).

At harvest, vermicompost + 75% FRD showed the maximum number of primary branches plant$^{-1}$ (7.83) which was statistically similar to poultry manure + 75% FRD (7.51). The use of chemical fertilizer showed the primary branches plant$^{-1}$

(7.03) which was followed by primary branches produced by vermicompost + 75% and poultry manure + 75% FRD treatments. The minimum number of primary branches plant$^{-1}$ (4.43) was found in cowdung + 25% FRD which was followed by control. Other treatments showed the intermediate results.

**Table 2. Effect of different combination of inorganic and organic fertilizers on number of primary branches plant$^{-1}$ of sesame**

| Treatments | Number of primary branches plant$^{-1}$ at different days after sowing (DAS) | | | |
|---|---|---|---|---|
| | **45** | **60** | **75** | **At harvest** |
| Control | 4.42 f | 4.95 d | 5.03 f | 4.98 d |
| Chemical fertilizer (FRD) | 7.70 a | 8.40 a | 7.17 c | 7.03 b |
| Mixed fertilizer | 6.93 b | 7.01 b | 5.87 e | 5.75 c |
| Cowdung + 25% FRD | 4.41 f | 5.32 d | 4.57 g | 4.43 e |
| Vermicompost + 25% FRD | 5.25 e | 6.15 c | 5.35 f | 5.26 d |
| Poultry manure + 25% FRD | 5.52 e | 6.32 c | 5.24 f | 5.13 d |
| Cowdung + 50% FRD | 5.33 e | 6.23 c | 5.13 f | 5.01 d |
| Vermicompost + 50% FRD | 6.01 d | 7.10 b | 6.07 de | 6.00 c |
| Poultry manure + 50% FRD | 6.54 bc | 7.45 b | 6.32 d | 6.12 c |
| Cowdung + 75% FRD | 6.37 cd | 7.22 b | 6.10 de | 5.97 c |
| Vermicompost + 75% FRD | 7.92 a | 8.85 a | 7.92 b | 7.83 a |
| Poultry manure + 75% FRD | 7.50 a | 8.58 a | 8.58 a | 7.51 a |
| $LSD_{(0.05)}$ | **.45** | **.54** | **.43** | **.37** |
| CV(%) | **7.55** | **8.03** | **7.23** | **6.56** |

* FRD = Fertilizer at Recommended Dose

### 4.3 Dry matter weight plant$^{-1}$

Dry matter weight plant$^{-1}$ was recorded at different stages of plant growth and development i.e. 30 DAS, 45 DAS, 60 DAS, 75 DAS and at harvest. Different combinations of organic and inorganic fertilizers significantly influenced dry matter weight plant$^{-1}$ (Table 3). The result indicated that chemical fertilizer gave the highest dry matter weight plant$^{-1}$ (9.67g) at 30 DAS which was statistically similar to poultry manure + 75% FRD (9.47g), vermicompost + 75% FRD (9.38g) and mixed fertilizer (9.08g). Control treatment showed the lowest dry matter weight plant$^{-1}$ (6.05g).

At 45 DAS, poultry manure + 75% FRD showed the highest dry matter weight plant$^{-1}$ (20.47g) which was statistically similar to vermicompost + 75% FRD (20.38g) and chemical fertilizer (20.13g). The second highest dry matter weight plant$^{-1}$ recorded from vermicompost + 50% FRD (18.73g) which was statistically similar to cowdung + 75% FRD (18.63g), poultry manure + 50% FRD (18.52g) and mixed fertilizer (18.25g). Control treatment showed the lowest dry matter weight plant$^{-1}$(13.17g).

Chemical fertilizer treated plot showed the highest dry matter weight plant$^{-1}$ (33.02g) at 60 DAS (Table 3) which was statistically similar to poultry manure + 75% FRD (32.31g) and vermicompost + 75% FRD (32.19g). Control treatment showed the lowest dry matter weight plant$^{-1}$ (22.62g) which was statistically similar to cowdung + 25% FRD (23.28g). Other treatments showed the intermediate results in respect of dry matter weight plant$^{-1}$ production parameter.

Plants treated with chemical fertilizer showed the highest dry matter weight plant$^{-1}$ (37.17g) at 75 DAS (Table 3) which was followed by the treatments comprised with vermicompost + 75% FRD (37.16g) and poultry manure + 75% FRD (37.06g). Control treatment showed the lowest dry matter weight plant$^{-1}$(26.35g) which was statistically similar to cowdung + 25% FRD (26.98g) treatment.

The result revealed that dry matter weight plant$^{-1}$ was highest (43.58g) of chemical fertilizer and statistically similar with the treatments of poultry manure + 75% FRD (42.76g) and vermicompost + 75% FRD (42.58g). Control treatment showed the lowest dry matter weight plant$^{-1}$ (31.97g) which was statistically similar to cowdung + 25% FRD (34.37g). Other treatments showed the intermediate results level of dry matter weight plant$^{-1}$.

**Table 3. Effect of different combination of organic and inorganic fertilizers on dry matter weight of sesame**

| Treatments | Dry matter weight (g) plant$^{-1}$ at different days after sowing (DAS) | | | | |
|---|---|---|---|---|---|
| | **30** | **45** | **60** | **75** | **At harvest** |
| Control | 6.05 d | 13.17 e | 22.62 e | 26.35 e | 31.97 f |
| Chemical fertilizer (FRD) | 9.67 a | 20.13 a | 33.02 a | 37.17 a | 43.58 a |
| Mixed fertilizer | 9.08 a | 18.25 b | 30.75 bc | 34.15 c | 39.5 b |
| Cowdung + 25% FRD | 7.03 c | 14.49 d | 23.28 e | 26.98 e | 34.37 ef |
| Vermicompost + 25% FRD | 7.44 c | 16.75 c | 27.05 d | 31.16 d | 36.46 c-e |
| Poultry manure + 25% FRD | 7.67 bc | 16.87 c | 26.92 d | 29.97 d | 35.85 de |
| Cowdung + 50% FRD | 7.56 bc | 16.73 c | 26.88 d | 31.08 d | 37.07 b-e |
| Vermicompost + 50% FRD | 8.17 b | 18.73 b | 29.53 c | 34.17 c | 38.76 b-d |
| Poultry manure + 50% FRD | 8.07 b | 18.52 b | 29.21 c | 34.24 c | 39.24 bc |
| Cowdung + 75% FRD | 8.13 b | 18.63 b | 29.95 c | 34.67 bc | 39.33 bc |
| Vermicompost + 75% FRD | 9.38 a | 20.38 a | 32.19 ab | 37.16 a | 42.58 a |
| Poultry manure + 75% FRD | 9.47 a | 20.47 a | 32.31 ab | 37.06 ab | 42.76 a |
| $LSD_{(0.05)}$ | **.68** | **1.08** | **1.72** | **2.45** | **2.96** |
| CV(%) | **8.62** | **6.24** | **6.15** | **7.65** | **7.89** |

*FRD = Fertilizer at Recommended Dose

**Yield attributes**

## 4.4 Capsules plant$^{-1}$

Number of capsules plant$^{-1}$ was significantly influenced by different combinations of organic and inorganic fertilizers (Table 4). The highest number of capsule plant$^{-1}$ (88.93) was recorded at harvest by the application of chemical fertilizer which was statistically similar with the application of poultry manure + 75% FRD (88.03), vermicompost + 75% FRD (86.87), mixed fertilizer (84.17) treatment combinations. The lowest number of capsules plant$^{-1}$ was recorded by control (68.23) which was statistically similar to the treatment combination of cowdung + 25% FRD (72.63). Intermediate data was recorded by the application of other treatments. The maximum plant height, number of flower, number of fruit, total fruit weight and fruit length was found from the application of vermicompost on *Hibiscus esculentus* was also reported by Vanmathi and Selvakumari (2012).

## 4.5 Seeds capsule$^{-1}$

Number of seeds capsule$^{-1}$ was influenced influenced by different combinations of organic and inorganic fertilizers (Table 4). The maximum no of seeds capsule$^{-1}$ (68.67) was recorded at harvest by the application of poultry manure + 75% FRD which was statistically similar to vermicompost + 75% FRD and chemical fertilizer (67.07 and 66.73, respectively). The minimum no of seed capsule$^{-1}$ (44.47) was recorded by control treatment which was statistically similar to the treatment comprised with cowdung + 25% FRD (47.33).

## 4.6 Weight of 1000 seed

Thousand seed weight was significantly influenced by different combinations of organic and inorganic fertilizers (Table 4). The table indicated that the highest 1000 seed weight (2.83g) was recorded at harvest by the application of chemical fertilizer applied plot which was statistically similar to poultry manure + 75% FRD (2.76g), vermicompost + 75% FRD (2.75g) and mixed fertilizer (2.72g) applied plots. The lowest 1000 seed weight (2.21g) was obtained by control treatment which was statistically similar to the treatments comprised with cowdung + 25% FRD (2.24g), vermicompost + 25% FRD (2.30g) and cowdung + 50% FRD (2.32g).

**Table 4. Effect of different combination of organic and inorganic fertilizers on yield attributes of sesame**

| Treatments | Capsules Plant$^{-1}$ (No.) | Seeds Capsule$^{-1}$ (No.) | Weight of 1000 seed (g) |
|---|---|---|---|
| Control | 68.23 h | 44.47 e | 2.21 e |
| Chemical fertilizer (FRD) | 88.93 a | 66.73 a | 2.83 a |
| Mixed fertilizer | 84.17 a-d | 60.47 b | 2.72 ab |
| Cowdung + 25% FRD | 72.63 gh | 47.33 de | 2.24 e |
| Vermicompost + 25% FRD | 76.90 fg | 50.53 cd | 2.30 e |
| Poultry manure + 25% FRD | 78.07 ef | 53.33 c | 2.48 d |
| Cowdung + 50% FRD | 77.83 ef | 52.52 c | 2.32 e |
| Vermicompost +50% FRD | 81.68 d-f | 59.86 b | 2.60 cd |
| Poultry manure + 50% FRD | 83.53 b-d | 60.66 b | 2.65 bc |
| Cowdung +75% FRD | 82.27 c-e | 60.35 b | 2.68 b |
| Vermicompost + 75% FRD | 86.87 a-c | 67.07 a | 2.75 ab |
| Poultry manure + 75% FRD | 88.03 ab | 68.67 a | 2.76 ab |
| $LSD_{(0.05)}$ | **4.98** | **3.65** | **.15** |
| CV(%) | **6.32** | **6.50** | **6.26** |

*****FRD = Fertilizer at Recommended Dose

## Yield

### 4.7 Seed yield (kg ha$^{-1}$)

Seed yield was significantly influenced by different combinations of organic and inorganic fertilizers (Table 5). The maximum seed yield (1656.4 kg ha$^{-1}$) was obtained from the application of chemical fertilizer which was statistically similar to the treatment combinations of poultry manure + 75% FRD and vermicompost + 75% FRD (1650.4 and 1637.24kg ha$^{-1}$, respectively). The minimum seed yield (919.2 kg ha$^{-1}$) was obtained from control treatment. Intermediate seed yield was obtained from other treatments. The result was consistent with the findings of Ghosh *et al*., 2013, who reported that integrated use of fertilizer, organic manure and *Azospirillum* produced higher seed and oil yield of sesame compared to 100% RDF through fertilizer alone.

### 4.8 Stover Yield (kg ha$^{-1}$)

Table 5 showed that stover yield was significantly influenced by different combinations of organic and inorganic fertilizers. The application of vermicompost + 75% FRD showed the maximum stover yield (2309.82 kg ha$^{-1}$) which was statistically similar to poultry manure + 75% FRD (2267.86 kg ha$^{-1}$) and chemical fertilizer (2254.82 kg ha$^{-1}$). Control showed the minimum stover yield (1498.41 kg ha$^{-1}$).

### 4.9 Biological Yield (kg ha$^{-1}$)

Biological yield of sesame was significantly influenced by different combinations of organic and inorganic fertilizers (Table 5). The maximum biological yield (3947.06 kg ha$^{-1}$) was obtained from the application of vermicompost + 75% FRD which was statistically similar to poultry manure + 75% FRD (3918.21 kg ha$^{-1}$) and chemical fertilizer (3911.22 kg ha$^{-1}$). The minimum biological yield (2417.57 kg ha$^{-1}$) was obtained from control.

**Table 5. Effect of different combination of organic and inorganic fertilizers on yield of sesame**

| Treatments | Seed Yield (kg ha$^{-1}$) | Stover Yield (kg ha$^{-1}$) | Biological Yield (kg ha$^{-1}$) |
|---|---|---|---|
| Control | 919.16 e | 1498.41 f | 2417.57 f |
| Chemical fertilizer (FRD) | 1656.40 a | 2254.82 ab | 3911.22 a |
| Mixed fertilizer | 1452.36 b | 2078.79 c | 3531.15 b |
| Cowdung + 25% FRD | 1152.76 d | 1849.22 e | 3001.98 e |
| Vermicompost + 25% FRD | 1218.82 cd | 1901.56 de | 3120.38 e |
| Poultry manure + 25% FRD | 1267.96 c | 1970.76 c-e | 3238.72 c-e |
| Cowdung + 50% FRD | 1245.30 c | 1925.82 c-e | 3171.17 de |
| Vermicompost + 50% FRD | 1397.24 b | 2018.16 cd | 3415.4 b-d |
| Poultry manure + 50% FRD | 1462.35 b | 2113.95 b | 3576.3 b |
| Cowdung + 75% FRD | 1425.76 b | 2057.65 cd | 3483.41 bc |
| Vermicompost + 75% FRD | 1637.24 a | 2309.82 a | 3947.06 a |
| Poultry manure +75% FRD | 1650.35 a | 2267.86 ab | 3918.21 a |
| LSD $_{(0.05)}$ | **107.89** | **161.98** | **279.93** |
| CV(%) | **8.03** | **8.20** | **8.43** |

*FRD = Fertilizer at Recommended Dose

### 4.10 Harvest Index (%)

Harvest index was significantly influenced by different combination of organic and inorganic fertilizers (Fig. 1). The figure showed that chemical fertilizer gave the highest harvest index (42.35%) which was statistically similar to poultry manure + 75% FRD (42.12%), vermicompost + 75% FRD (41.48%), mixed fertilizer (41.13%), cowdung + 75% FRD (40.93%), vermicompost + 50% FRD (40.91%) and poultry manure + 50% FRD (40.89%). Control treatment gave the lowest harvest index (38.02%) which was statistically similar to cowdung + 25% FRD (38.4%), vermicompost + 25% FRD (39.06%), poultry manure + 25% FRD (39.15%) and cowdung + 50% FRD (39.27%).

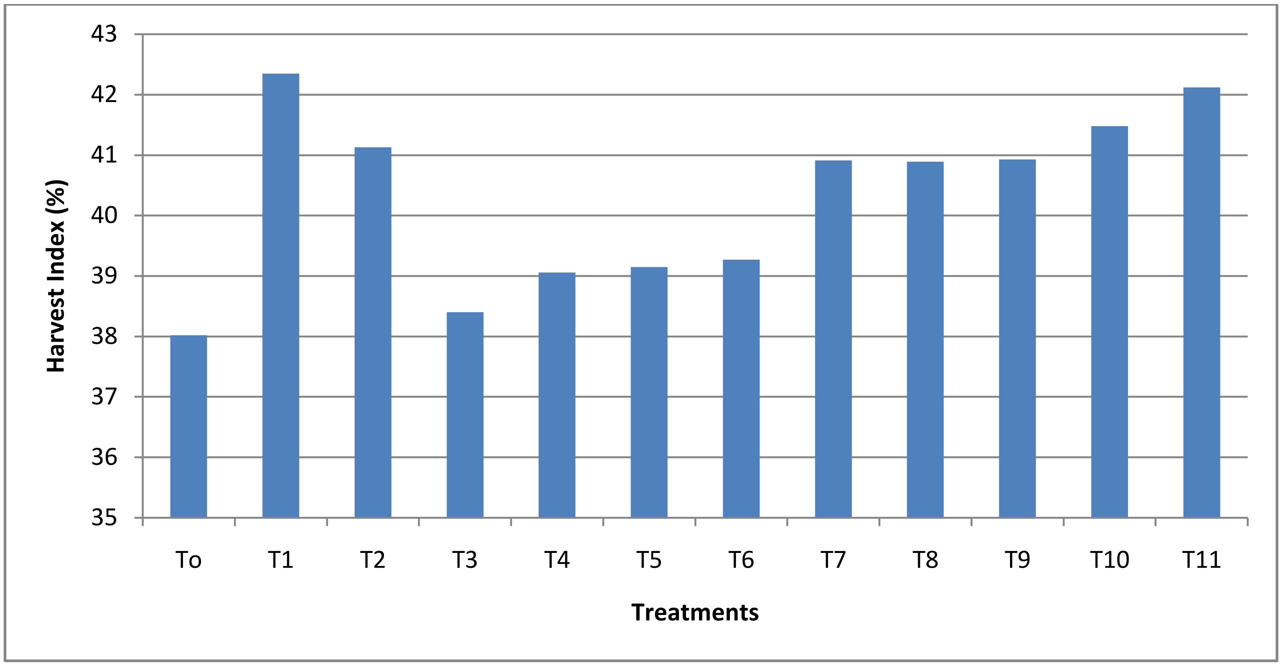


**Figure 1. Effect of different combinations of inorganic and organic fertilizer On the harvest index of sesame ($LSD_{0.05}$ = 2.43).**

Here, $T_0$ = Control, $T_1$ = Chemical Fertilizer at recommended dose, $T_2$ = Mixed Fertilizer, $T_3$ = Cowdung + 25% FRD, $T_4$ = Vermicompost + 25% FRD, $T_5$ = Poultry manure + 25% FRD, $T_6$ = Cowdung + 50% FRD, $T_7$ = Vermicompost + 50% FRD, $T_8$ = Poultry manure + 50% FRD, $T_9$ = Cowdung + 75% FRD, $T_{10}$ = Vermicompost + 75% FRD, $T_{11}$ = Poultry manure + 75% FRD (FRD = Fertilizer at Recommended Dose).

# CHAPTER-V

# SUMMARY AND CONCLUSION

An experiment was conducted at the Sher-e-Bangla Agricultural University Farm Dhaka-1207 (Tejgaon soil series under AEZ No 28) during Kharif-1 (March-June), 2015 to study the influence of different combination of inorganic and organic fertilizers in sesame. The soil texture was silty clay loam having pH 6.8 and organic carbon content of 0.68%. The design of the experiment was Randomized Complete Block design followed by 12 treatments with three replications. The size of each plot was 4m × 1.5m. The treatments of the experiment were 1) $T_0$ = control, 2) $T_1$ = chemical fertilizer, 3) $T_2$ = mixed fertilizer, 4) $T_3$ = cowdung + 25% FRD, 5) $T_4$ = vermicompost + 25% FRD, 6) $T_5$ = poultry manure + 25% FRD, 7) $T_6$ = cowdung + 50% FRD, 8) $T_7$ = vermicompost + 50% FRD, 9) $T_8$ = poultry manure + 50% FRD, 10) $T_9$ = cowdung + 75% FRD, 11) $T_{10}$ = vermicompost + 75% FRD, 12) $T_{11}$ = poultry manure + 75% FRD.

Seeds of BARI Til-4 were sown on 5 March, 2015 and the crops were harvested on 7 June, 2015. Plant height (cm), number of branches plant$^{-1}$, dry matter weight plant$^{-1}$, number of capsules plant$^{-1}$, number of seeds plant$^{-1}$, 1000 seed weight (g), seed yield (kg ha$^{-1}$), stover yield (kg ha$^{-1}$) etc. were collected.

All the collected data were statistically analyzed by Statistix 10 following F-test and the mean comparison was made by LSD at 5% level of probability.

Different combinations of organic and inorganic fertilizers significantly influenced plant height (cm), number of branches plant$^{-1}$, dry matter weight plant$^{-1}$, number of capsules plant$^{-1}$, number of seeds plant$^{-1}$, 1000 seed weight (g), seed yield (kg ha$^{-1}$), stover yield (kg ha$^{-1}$), biological yield (kg ha$^{-1}$) and harvest index (%).

The tallest plant (111.78 cm) at harvest was obtained by chemical fertilizer which was statistically similar to poultry manure + 75% FRD (110.85 cm), vermicompost + 75% FRD (110.16 cm), cowdung + 75% FRD (107.38 cm) and poultry manure + 50% FRD (105.87 cm). The maximum no of branches plant$^{-1}$ (7.83) at harvest was obtained by vermicompost + 75% FRD which was statistically similar to poultry manure + 75% FRD (7.51). The highest dry matter weight plant$^{-1}$ (43.58g) at harvest was obtained by chemical fertilizer which was statistically similar to poultry manure + 75% FRD (42.76g) and vermicompost + 75% FRD (42.58g). The highest no. of capsules plant$^{-1}$ (88.93) was obtained by chemical fertilizer which was statistically similar to poultry manure + 75% FRD (88.03), vermicompost + 75% FRD (86.87). The maximum no of seeds capsule$^{-1}$(68.67) was obtained by poultry manure + 75% FRD which was ststitically similar to vermicompost + 75% FRD (67.07) and chmical fertilizer (66.73). The highest 1000 seed weight (2.83g) was obtained by chemical fertilizer which was statistically similar to poultry manure + 75% FRD (2.76g), vermicompost + 75% FRD (2.75g). The maximum seed yield (1656.4 kg ha$^{-1}$) was obtained by chemical fertilizer which was statistically similar to poultry manure + 75% FRD (1650.4 kg ha$^{-1}$) and vermicompost + 75% FRD (1637.24 kg ha$^{-1}$). The maximum stover yield (2309.82 kg ha$^{-1}$) was obtained by vermicompost + 75% FRD which was statistically similar to poultry manure + 75% FRD (2267.9 kg ha$^{-1}$) and chemical fertilizer (2254.8 kg ha$^{-1}$). The maximum biological yield (3947.06 kg ha$^{-1}$) was obtained by vermicompost + 75% FRD which was statistically similar to poultry manure + 75% FRD (3918.21 kg ha$^{-1}$) and chemical fertilizer (3911.22 kg ha$^{-1}$). The highest harvest index (42.35%) was obtained by chemical fertilizer which was statistically similar to poultry manure + 75% FRD (42.12%), vermicompost + 75% FRD (41.48%), mixed fertilizer (41.13%), cowdung + 75% FRD (40.93%), vermicompost + 50% FRD (40.91%), poultry manure + 50% FRD (40.89%).

Therefore, it may be concluded from the results that poultry manure + 75% FRD and vermicompost + 75% FRD combination seems can be used as the substitute of application of only chemical fertilizer in commercial sesame production. These combinations can also reduces the use of 25% chemical fertilizer which can save the environment and soil from pollution.

However, to reach a specific conclusion , this experiment may be conducted taking more combination of organic and inorganic fertilizer at different Agro-ecological zones of the country.

# CHAPTER-VI

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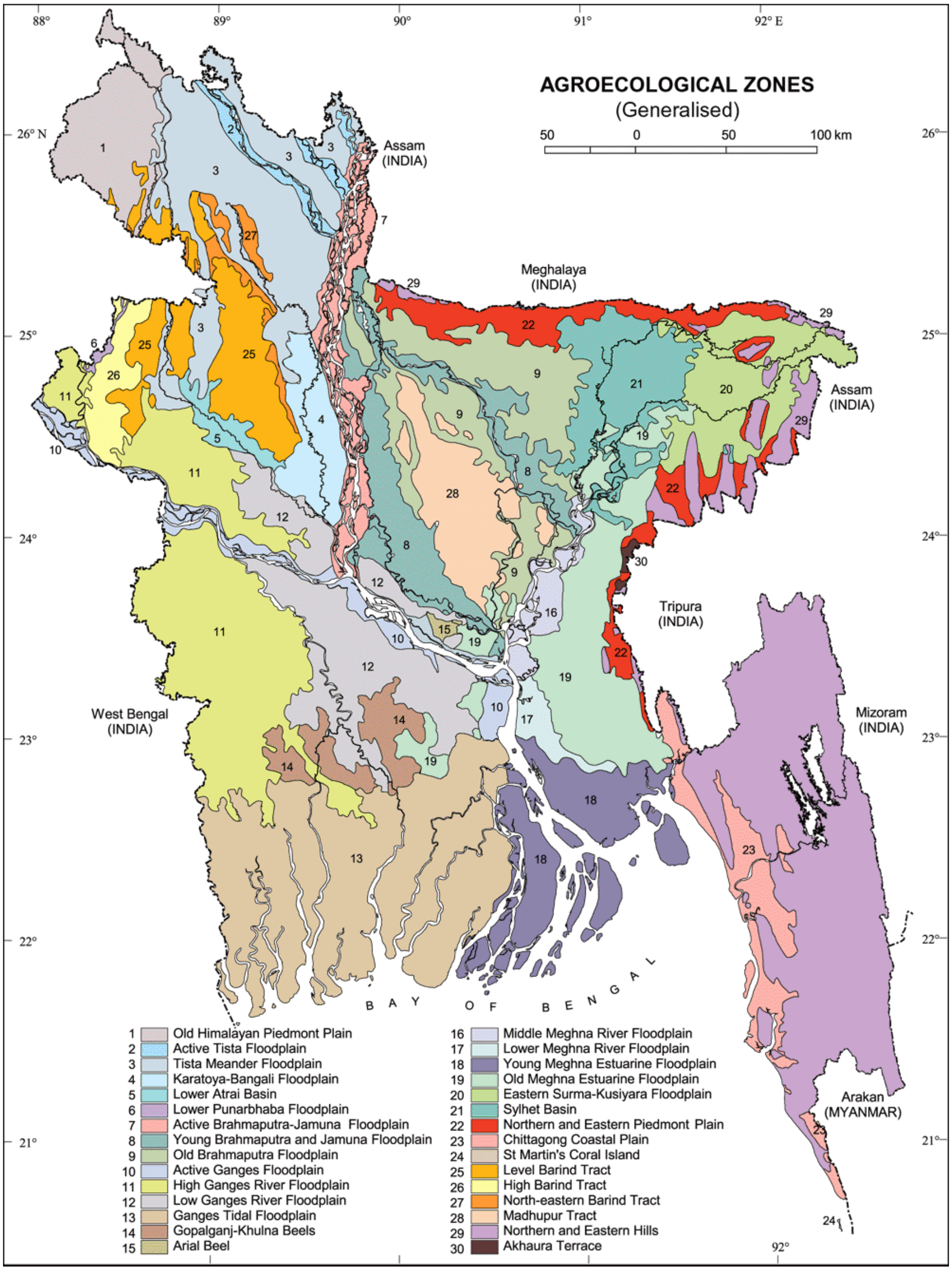
# APPENDICES

## Appendix I Experinemtal location on the map of Agro-ecologican Zones of Bangladesh



**Appendix II. Characteristics of soil of experimental field**

**A. Morphological characteristics of the experimental field**

| **Morphological features** | **Characteristics** |
|---|---|
| Location | Sher-e-Bangla Agricultural University Research Farm, Dhaka |
| AEZ | AEZ-28, Modhupur Tract |
| General Soil Type | Deep Red Brown Terrace Soil |
| Land type | High land |
| Soil series | Tejgaon |
| Topography | High |

**B. The initial physical and chemical characteristics of soil of the experimental site (0-15 cm depth)**

| **Physical characteristics** | |
|---|---|
| **Constituents** | **Percent** |
| Sand | 26 |
| Silt | 45 |
| Clay | 29 |
| Textural class | Silty clay loam |

| **Chemical characteristics** | |
|---|---|
| **Soil character** | **Value** |
| pH | 6.8 |
| Organic carbon (%) | 0.45 |
| Organic matter (%) | 0.78 |
| Total nitrogen (%) | 0.071 |
| Available P (ppm) | 7.42 |
| Exchangeable K (me/100g soil) | 0.08 |

Source: Soil Resource and Development Institute (SRDI), Farmgate, Dhaka

**Appendix III. Monthly meterological information during the period from March to June, 2015**

| Year | Month | Air temperature ($^0$C) | | Relative humidity (%) | Total rainfall (mm) |
|---|---|---|---|---|---|
| | | Maximum | Minimum | | |
| 2015 | March | 32.20 | 20.04 | 66.69 | 66.70 |
| 2015 | April | 34.53 | 24.06 | 68.08 | 90.01 |
| 2015 | May | 33.84 | 25.11 | 86.13 | 297.9 |
| 2015 | June | 35.64 | 27.24 | 78.24 | 302.6 |

Source : Meterological Centre Agargaon, Dhaka

**Appendix IV. Analysis of variance of the data on plant height of sesame as influenced by different combination of inorganic and organic fertilizers**

| Source of variation | df | Mean square of plant height at different days after sowing (DAS) | | | | |
|---|---|---|---|---|---|---|
| | | 30 | 45 | 60 | 75 | At harvest |
| **Replication** | 2 | 4.84 | 17.16 | 24.39 | 2.02 | 19.74 |
| **Fertilizers** | 11 | 49.02* | 179.29* | 270.57* | 300.49* | 295.28* |
| **Error** | 22 | 9.30 | 27.46 | 38.18 | 40.92 | 43.24 |

*Significant at 5% level of significance

$^{NS}$ Non sigficant

**Appendix V. Analysis of variance of the data on number of branches plant$^{-1}$ of sesame as influenced by different combination of inorganic and organic fertilizers**

| Source of variation | Df | Mean square of number of branches plant$^{-1}$at different days after sowing (DAS) | | | |
|---|---|---|---|---|---|
| | | **45** | **60** | **75** | **At harvest** |
| Replication | 2 | 0.102 | 0.104 | 0.048 | 0.326 |
| Fertilizers | 11 | 4.39* | 4.62* | 4.48* | 3.40* |
| Error | 22 | 0.21 | 0.31 | 0.195 | 0.15 |

*Significant at 5% level of significance

NS Non sigficant

**Appendix VI. Analysis of variance of the data on dry matter weight plant$^{-1}$ of sesame as influenced by different combination of inorganic and organic fertilizers**

| **Source of variation** | **df** | **Mean square of dry matter weight plant$^{-1}$ at different days after sowing (DAS)** | | | | |
|---|---|---|---|---|---|---|
| | | **30** | **45** | **60** | **75** | **At harvest** |
| **Replication** | 2 | 0.42 | 29.33 | 33.86 | 104.86 | 153.28 |
| **Fertilizers** | 11 | 3.59* | 15.53* | 34.39* | 42.17* | 37.04* |
| **Error** | 22 | 0.49 | 1.23 | 3.09 | 6.32 | 9.22 |

*Significant at 5% level of significance

NS Non sigficant

**Appendix VII. Analysis of variance of the data on yield contributing characters of sesame as influenced by different combination of inorganic and organic fertilizers**

| Source of variation | df | Mean square value of | | |
|---|---|---|---|---|
| | | No. of capsule plant$^{-1}$ | No. of seeds capsule$^{-1}$ | 1000 seed weight |
| **Replication** | 2 | 60.97 | 80.98 | 0.00017 |
| **Fertilizers** | 11 | 118.14* | 190.28* | 0.151* |
| **Error** | 22 | 26.01 | 14.03 | 0.025 |

*Significant at 5% level of significance

$^{NS}$ Non sigficant

**Appendix VIII. Analysis of variance of the data on yield characters of sesame as influenced by different combination of inorganic and organic fertilizers**

| Source of variation | df | Mean sqare value of | | | |
|---|---|---|---|---|---|
| | | Seed yield | Stover yield | Biological yield | Harvest index |
| **Replication** | 2 | 4630 | 100019 | 120506 | 147.048 |
| **Fertilizers** | 11 | 150077* | 147495* | 590294* | 6.393* |
| **Error** | 22 | 12178 | 27446 | 81975 | 6.17 |

*Significant at 5% level of significance

$^{NS}$ Non sigficant