EFFECT OF DETOPPING ON THE GROWTH AND YIELD OF SESAME

NUSRAT JAHAN

DEPARTMENT OF AGRONOMY
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2015

EFFECT OF DETOPPING ON THE GROWTH AND YIELD OF SESAME

BY

NUSRAT JAHAN

Reg. No. : 09-03472

A Thesis

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

SEMESTER: JANUARY - JUNE, 2015

Approved By:

Prof. Dr. H.M.M. Tariq Hossain	**Prof. Dr. Md. Fazlul Karim**
Supervisor	**Co-Supervisor**

Prof. Dr. Md. Fazlul Karim

Chairman
Examination Committee

DEPARTMENT OF AGRONOMY

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that thesis entitled **' EFFECT OF DETOPPING ON THE GROWTH AND YIELD OF 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** in **Agronomy**, embodies the result of a piece of *bona fide* research work carried out by **NUSRAT JAHAN** Registration number: **09-03472** 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 duly been acknowledged.

Dated:
Dhaka, Bangladesh

Dr. H.M.M. Tariq Hossain
Professor
Supervisor

DEDICATED

TO

MY BELOVED PARENTS

ACKNOWLEDGEMENT

All praises are due to the Almighty Allah Who has enabledtha author to complete the research work and thesis successfully for the degree of master of science in agronomy.

The author would like to express her heartiest respect, deepest sense of gratitude, profound appreciation and ever indebtedness to her Supervisor**Dr. H.M.M. Tariq Hossain**, professor, Department of Agronomy, Sher-e-Bangla Agricultural University, (SAU), Dhaka for his sincere guidance, scholastic supervision, constructive criticism, and constant inspiration throughout the course and in preparation of the manuscript of the thesis.

The author would like to express her sincere respect to her Co-supervisor and also the chairman of the department**Dr. Md. FazlulKarim,** professor, department of Agronomy, Sher-e-Bangla Agricultural University, (SAU), Dhaka for his utmost co-operation, constructive suggestion, constructive criticism and constant inspiration throughout the research work as well as preparation of the manuscript of the thesis.

Heartiest thanks to Professor Md. Shadat Ulla,Honorable Vice-chancellor, Sher-e-Bangla Agricultural University (SAU), Dhaka for providing necessary facilities and conductive atmosphere to accomplish the research work

The author is thankful to all of her close friends specially Md.KamrulHasanto cooperate and help her during taking data from the field and to take care of her experimental plot time to time. Special thanks to her sisters, relatives, well-wishers and friends for their inspiration, help and encouragement throughout the study period.

Mere diction is not enough to express her profound gratitude and deepest appreciation to her parents for their ever ending prayer, encouragement, sacrifice and dedicated efforts to educate her to this level.

Dated: June,2015

Place:

SAU, Dhaka ***TheAuthor***

EFFECT OF DETOPPING ON THE GROWTH AND YIELD OF SESAME

ABSTRACT

A field experiment was conducted to evaluate the effect of detopping on the growth and yield of sesame varieties at the research farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during late summer to early monsoon (April-July) of 2014. The experiment comprised of morphological modification of sesame plant through detopping at four different stages i.e. detopping at 25 DAS (D_1), detopping at 35 DAS (D_2), detopping at 45 DAS (D_3) and without detopping (D_0) of some sesame varieties i.e. BARI Til 3, BARI Til 4 and a local variety named Atshira. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Results revealed that effects of detopping on varieties were significant for growth and yield parameters (except 1000-seed weight). Maximum plant height (103.15 cm) was found from Atshira (Local) without detopping the plants**,** BARI Til 3 produced maximum number of branches plant^{-1} (24) when detopped at 45 DAS**,** the highest Leaf Area Index (LAI) was recorded in Atshira (Local)detopped at 35 DAS. Although maximum number of seed capsule^{-1} was found from Atshira (Local) with no detopping, maximum number of capsule plant^{-1} resulting highest seed yield (1168.3 kg ha^{-1}) were recorded from BARI Til 3 when detopped at 35 DAS.

LIST OF CONTENTS

LIST OF CONTETS(Contd.)

LIST OF CONTETS(Contd.)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBRIVIATION

ABBRIVIATION	FULL NAME
AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
Cont'd	Continued
cm	Centimeter
DAS	Days after Sowing
^{0}C	Degree Centigrade
et al.	and others
etc.	Etcetera
FAO	Food and Agriculture Organization
G	Gram
HI	Harvest Index
IAA	Indole Acetic Acid
Kg	Kilogram
Kg/ha	Kilogram per hectare
LSD	Least significant difference
LAI	Leaf Area Index
m	Meter
ns	Non-significant
%	Percentage
CV%	Percentage of Coefficient of Variance
SRDI	Soil Resources and Development Institute
viz.	Namely

Chapter 1
Introduction

Chapter 1

Introduction

Sesame (*Sesamum indicum* L.) belongs to the family Pedaliaceae and is grown throughout the tropics and sub tropics. Sesame is adorned as Queen of oil seeds. Among the oil seed crops, sesame ranks first for its higher oil content (46-64%) with 6335 Kcalkg^{-1} of dietary energy in seeds (Kumar and Goel, 1994). Beside this consumption benefits, sesame has important agricultural attributes. It grows well in tropical and subtropical climates; it can grow on only the residual soil moisture without rainfall or irrigation, and can be grown in mixed stands with diverse crops (Ashri, 2007). It is the third most important oil seed crops in Bangladesh and covers an area of 45840 hectare of land having a production of 35007 metric tons (BBS, 2004). But yield (0.612 t/ha) is very poor in our country compared to yield of China (1.009 t/ha) and Egypt (1.228 t/ha) (FAO, 2003) whereas it has a yield potential of around 2 t/ha.

Thus, it offers considerable scope of improvement in its production through the exploitation of improved agronomic manipulations of the crops. Yield is the manifestation of various physiological processes occurring in plants and they are usually modified by management practices in an environment. The development of axillary buds is inhibited normally by Indole Acetic Acid (IAA) produced in the apical meristem. If the shoot apex is subsequently decapitated (also referred as detopped), apical dominance is released and one or more of these lower axillary buds begins to grow out (Cline,1997). Clipping of terminal bud which activates the dormant lateral buds to produce more branches is an important operation for increasing the sesame yield; commented by Ramanthan and Chandrashekharan (1998). Increased number of primary branches/plant of sesame was found by Singh *et al.* (2013) when the plants were detopped at different stages and suggested that the utilization of photosynthates by the crop for the production of lateral branches could be the reason. But research on this technique “Detopping” in sesame is meager in our country. Considering the above facts a research was designed on the following objectives:

- ❖ To examine the effect of detopping on the growth and yield attributes of sesame.
- ❖ To find out the optimum time of detopping for yield maximization in sesame.
- ❖ To study the response of sesame varieties on the detopping managements.

Chapter 2

Review of literature

Chapter 2

Review of literature

2.1. Historical preview of sesame:

It would be appropriate here to begin by referring to Anderson (1960) that "Evolution under domestication is a process rather than an event, a process whose important early stages are still matters of experiment". In fact, evolution of any kind is a process and not an event. But there are many difficulties in tracing the course of these processes in this group because of the meager experimental studies in this genus and family. We shall, therefore, have to take recourse to evidence from other sources such as archaeology, history, philology etc.

Sesame is a very ancient crop, one of the oldest oil crops. According to Fluckiger and Hanbury (1879), in the days of Pliny sesame oil was an export item from Sind to Europe by way of the Red Sea. In the Middle Ages, the plant was known as ‘Suseman or ‘Sempsen’, a corruption of the Arabic ‘Simsin’ or ‘Samsim’. Charred sesame seeds about 5000 years old, were found in archaeological excavations in Harappa, mentioned by Fuller in 2003. About 34 species of Sesame are found in the world mainly in tropical South Africa and Asia. Out of those 18 are found in S. Africa, Nigeria, Sudan, Congo and 8 are found in the Indian region. De Candolle

(1886) was of opinion that India might have received Sesame from Malayan & Indonesian region in pre-Aryan period, possibly, by the South-Indian navigators. Watt (1893) was of opinion that its origin is from more than one place, and must have been cultivated in Euphrates valley and in Bokhara of Afghanistan. Recently, the African origin has also been well established by Bedigion in 2011.

According to Ihlenfeldt and Grabow-Seidensticker (1979); Despite the fact that the majority of the wild species of the genus *Sesamum* are native to sub-saharan Africa, the origin of cultivated sesame, its progenitor and its domestication has been a controversial subject since long times as according to some, the progenitor of cultivated sesame is a taxon *Sesamum latifolium*, 2n = 32 from African continent. Later studies by Bedigian in 2003 refuted the concept of African progenitor of sesame and suggested that cultivated sesame has been derived from wild populations native to Indian subcontinent, the western Indian peninsula and parts of Pakistan. Researchers have demonstrated that sesame was first domesticated in India and provided convincing evidences of morphological and cytological affinities between domesticated sesame and the South Indian native *Sesamum malabaricum* (Bedigian, 2003).

Esquinas-Alcazar (2004) has shown its origin in the Central Asian Region (Afghanistan & Iran). The secondary centers are: Abyssinia, Afghanistan, Uzbekistan, India, Bangladesh, Myanmar (Burma), Central Asia, and

China. Nayar and Mehra (2009) mentioned that, Sesame is among the important oil-yielding plants. Its importance is proportionately more than its share of production because of its concentration in some regions of the world and its many uses as compared to other oil-yielding crops. It is essentially a crop of the tropics.

2.2. Botany of Sesame:

2.2.1. Taxonomy of sesame

The taxonomic work on Pedaliaceae family has been discussed by Bruce (1953). *Sesamum* was described by Linnaeus in 1754 in Genera *Plantarum*. This generic name was taken by Hippocrates from the Arabic "semsin" (Baily, 1949). Workers like Endlicher, Bernhardi, De Candolle, and Stapf have revised the genus, dividing it into sub-genera and sections based on morphology of leaves (simple, tripartite, trifoliate) and seeds (winged, wingless). There is considerable uncertainty in enumerating species of *Sesamum*. *Index Kewensis* has so far listed 36 species. Perhaps 34 of these are valid species.

Bruce (1953) mentioned in his study that, Carolus Linnaeus first described two species of sesame i.e. *S. indicum* and *S. orientale*. Later De Candolle united them and preferred the specific epithet *indicum* to *orientale*. It belongs to the family Pediliaceae. Rendle (1963) mentioned that, The Pedaliaceae is a small family of annual or perennial herbs, more rarely shrubs, with opposite leaves or with the upper leaves spirally arranged and generally axillary flowers. There are about 60 species in 16 genera, distributed in tropical and southern Africa, south and Southeast Asia and tropical Australia. The Pedaliaceae is characterized by a superior ovary, usually two-celled, with cells often completely or partially divided by false septa, each compartment containing single to many ovules attached to the central placenta.

2.2.2. Morphological features

According to USDA Plant Guide, Sesame (*Sesamum orientale*) is an annual broad-leaf plant that grows 5-6 ft (155-185 cm) tall. It produces a 1-2 in (2.5-5cm) long white, bell-shaped inflorescence growing from the leaf axils (where the leaf stalk joins the stem). The blooms do not open all at once, but gradually, from the base of the stem upwards to the top of the plant. The flowers are both male and female and will self-pollinate. The seed is produced in a 1-1.5 in (2.5-3.8 cm) long, divided seed capsule that opens when the seeds are mature. There are 8 rows of seed within each seed capsule, and seed may be yellow, white, brown, or black (Morris, 2002).

Due to the non-uniform, indeterminate nature of the bloom period, the reproductive, ripening, and drying phases of the seed tend to overlap.

Seed lowest on the plant will mature first, even as the upper part of the plant is still flowering or has just formed seed capsules. Sesame varieties have single or multiple stems. The stem is covered with short, soft hairs. Sesame is very leafy; with 3-5 in (7.5-12.7 cm) long, some what rough, lance-shaped, entire upper leaves, and tri-lobed lower leaves.

2.2.3. Growth and yield contributing characters

Langham *et al.* (2008) reported that Sesame is notable for its ability to grow under droughty conditions and in extreme heat. It is often grown where cotton can grow, under conditions few other crops can survive, requiring very few inputs. These attributes make sesame an excellent candidate for low-input sustainable food systems. Langham *et al.* (2008) commented sesame is deep-rooted and will scavenge nutrients from below most crop root zones. Bahrami and Razmjoo (2012) found sesame has moderate salt tolerance, but will not grow under flooded conditions. Langham *et al.*(2008) commented the plant will have a better chance of survival when it is grown in hotter than optimal temperatures rather than lower than optimal temperatures. Khidir and Osman (1970) investigated Correlation coefficients between pairs of ten characters in 90 lines of sesame. Yield per plant was positively and significantly correlated with stem height, branches plant^{-1}, capsule length, capsule plant^{-1}, seeds capsule^{-1}, seeds plant^{-1} and 1000-seed weight**.**

Twenty seven core accessions and three genetic male sterile lines were investigated by Yingzhong and Yishou at the Oil Crops Research Institute of CAAS, Wuhan, China in 2001 to study the genotypic correlations and path coefficient analysis in sesame. Nine characters were investigated: days to flowering, plant height, time to first capsule, number of capsules plant^{-1}, capsule length, capsule width, number of seeds capsule^{-1}, 1000-seed weight and seed yield plant^{-1}. The results showed that number of capsules plant^{-1} and plant height had significantly positive correlations and direct path coefficient on seed yield plant^{-1}.

Correlation between yield and six yield contributing characters, namely days to 50 per cent flowering, plant height, number of branches, number of capsules, 1000-seed weight and oil content and three physiological characters *viz*. leaf area index, photosynthetic rate and harvest index was studied by Kumaresan and Nadarajan (2002) in 64 genotypes including 48 hybrids and 16 parents. Except for days to 50 per cent flowering and oil content, all the remaining characters showed a significant and positive correlation with seed yield. They also had a significant and positive correlation between each other.

An experiment was carried out by Ukaan and Ogbonna (2012) to determine the genetic variability and character association in 13 sesame accessions. The correlation matrix in their experiment showed that seed yield/plant correlated positively and significantly with some traits including number of branches per plant. Thus morphological modification of sesame can greatly influence its seed yield. Dettoping is such a practice of morphological modification for better yield.

2.3. Detopping technique:

2.3.1. Apical dominance and Detopping

Detopping, also sometimes referred to by such terms as apex removal or excision, clipping, detopping, defoliation, pruning, trimming, tipping, shearing, heading, herbivory, browsing, meristem destruction, and pinching; is an effective agricultural practice for some crops. This practice is based on the theory of apical dominance.

According to Tamas (1987), within a few hours after apex removal, measurable increases in the length of the emerging lateral bud can be detected in some species. In other species the lag period may be longer depending upon the degree of inhibition and the stage of the cell cycle at the time of inhibition. In the days and weeks following decapitation, subsequent elongation and development of the lateral bud into a branch shoot occur. Steeves and Sussex (1989) described, ‘‘. . .commonly at this time [after bud formation] the dominance of the main apex is expressed in the inhibition of further development of the lateral apices and they remain as axillary buds, often for long periods and sometimes permanently unless the main apex is removed''. Cline (1997) defined apical dominance as "the control exerted by the shoot apex over the outgrowth of the lateral buds". This is a classic example of a developmental correlation where one organ of a plant affects another organ (Sachs, 1991).So, in this technique the top portion of the plants are excised to enhance lateral branch formation. If the shoot apex is subsequently decapitated apical dominance is released and one or more of these lower axillary buds begins to grow out (Cline, 1997).

Benner (1988) conducted an experiment on field pennycress (*Thlaspi arvense*). He examined the effects of removal of the shoot apex and of mineral nutrient addition on branching and seed production in *Thlaspi arvense*. Individual plants received no, early, or late apex removal and no, early, or late nutrient addition in a two-way factorial experiment. Apex removal led to greater production of secondary branches. Total seed weight plant^{-1} was higher for early- than late-removal plants under all nutrient treatments, but intact controls produced the highest total weight of seeds in two of three nutrient treatments, because their seeds were heavier.

Argall and Stewart (1984) experimented with Cowpea *Vigna unguicuiata* (L.) Walp.] to define more clearly the role of the early loss of apical dominance on yield of cowpea. Decapitation at the fifth leaf stage resulted in an increase in branching components, yields and harvest indices, while vegetative dry matter accumulation was reduced.

Naberand Aarssen (1998) conducted an experiment to interpret patterns of branching in natural populations of *Verba scumthapsus* L. (Scrophulariaceae) and to investigate whether the suppression of lateral meristems by apical dominance imposes a potential fitness cost in this species. Disruption of apical dominance by removal (clipping) of shoot apices resulted in shorter plants and greater branching but did not affect total biomass, number of fruits, number of seeds per plant or percent germination of seeds. Seeds from clipped plants, however, were approximately 30% heavier than those from unclipped plants, indicating that apical dominance imposes a potential fitness cost to *V. thapsus.*

2.3.2. Detopping of sesame

According to Ramanthan and Chandrashekharan (1998), clipping of terminal bud which activates the dormant lateral buds to produce more branches is an important operation for increasing the sesame yield. Another experiment was carried out by Singh *et.al.*(2013) to evaluate the effect of nipping in combination with different doses of nitrogen. Result showed that, Nitrogen management levels and nipping schedule significantly affected the growth (plant height and primary branches plant^{-1}) and yield attributes (capsules plant^{-1}, seeds siliqua^{-1} and 1000-seed weight) of sesame at harvest as well as net returns individually.

A field experiment was conducted by Kokilavani *et al.*(2007) to investigate the influence of morphological modification through terminal clipping in some selected varieties of sesame. The results of the study indicated that terminal clipping done at 35 DAS found to improve the crop architecture, yield attributes and yield of the sesame variety SVPR 1. The variety TMV 4 was also considered as an appropriate alternative in recording equal growth and yield parameters and yield for the same clipping practice. Thus nipping or clipping or detopping, whatever the name is, provides ample opportunity for investigation in respect to increasing the yield of sesame.

Chapter 3

Materials and Methods

Chapter 3

Materials and methods

The experiment was conducted at the agronomy field, Sher-e-Bangla Agricultural University, Dhaka during 10 April to 25 July, 2014. This chapter deals with a brief description on experimental site, climate, soil, land preparation, layout, experimental design, intercultural operations, data recordings and there analyses.

3.1. Site description

The experiment was conducted at the research field of Agronomy Department, Sher-e-Bangla Agricultural University, Dhaka under the Agro-ecological zone of Modhupur tract, AEZ-28. The land was situated at 23°41' N latitude and 90°22' E longitude at an altitude of 8.6 meter above sea level.

3.2. Climate

The experimental area was under the sub-tropical regions that is characterized by high temperature, high humidity and heavy rainfall with occasional gusty winds in kharif season (March to July) associated with moderately low temperature during the Rabi season.

3.3. Soil

The soil of the experiment field belongs to the general soil type, shallow red brown terrace soil under Tejgaon series. Top soils are silty clay in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. The experiment area was flat having available irrigation and drainage system. The land was above flood level and sufficient sunshine was available during the experimental period. Soil samples from 0 to 15 cm depth were collected from experimental field. The analyses were done from Soil Resources and Development Institute (SRDI), Dhaka. (Appendix II)

3.4. Planting material

Three sesame varieties viz. BARI Til 3, BARI Til 4 and Atshira (Local) were used as planting material. The first two high yielding varieties were developed by Bangladesh Agricultural Research Institute (BARI), Gazipur and the latter is a local variety. All the varieties were collected from Bangladesh Agricultural Research Institute (BARI).

3.5. The experimental treatment

The experimental treatments consisted of two factors i.e. Varieties and detopping at different stages.

Factor A: Varieties

Varieties	Designated symbols
BARI Til 3	V_1
BARI Til 4	V_2
Atshira (Local)	V_3

Factor B: Detopping

Detopping	Designated symbols
Detopping at 25 DAS	D_1
Detopping at 35 DAS	D_2
Detopping at 45 DAS	D_3
Without detopping (Control)	D_0

3.6. Design and layout of the experiment

The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising three replications. The size of each unit plot area was 3 meter x 2 meter. The inter block and row spaces were used as foot path and irrigation or drainage channels.

3.7. Conducting the experiment

3.7.1. Germination test

Before sowing of the seeds, germination tests were made in the laboratory and germination percentage counted over 92 using the following formula-

$$\text{Percentage of germination} = \frac{\text{Number of germinated seed}}{\text{Number of seed set for germination}} \times 100$$

3.7.2. Land preparation

The land was opened with the tractor drawn disc plough. Ploughed soil was then brought into desirable fine tilth condition by 6 operations of ploughing and harrowing with country plough and ladder. The stubble and weeds were removed. Experimental lands were divided into unit plots following the design of the experiment. The plots were spaded one day before sowing of seeds.

3.7.3. Fertilizer application

Cow dung was applied at the rate of 10 t/ha during the land preparation. 60 kg N/ha were applied at two installments in the form of Urea. Other fertilizers were applied at the rate of 30kg/ha of P, 25kg/ha of K, 5kg/ha of S, 0.34kg/ha of B and 1.8 kg/ha of Zn.

3.7.4. Seed sowing

Seeds of sesame were sown on 10 April, 2014 maintaining 30 cm line to line distance @ 8 kg ha^{-1}. Seeds were placed around two cm depth and then rows were covered with loose soil property.

3.7.5. Intercultural operation

The following intercultural operations were done for ensuring normal growth of the crop.

3.7.5.1. Weeding

During plant growth period two hand weeding were done using Nirani. First weeding was done at 20 DAS followed by second weeding at 30 DAS.

3.7.5.2. Thinning

Thinning was done with care so as to maintain a uniform plant population in each experimental plot. The job was done in two times at 10 DAS and 20 DAS.

3.7.5.3. Irrigation and drainage

One pre-sowing irrigation was done to maintain the equal seed germination of sesame. After sowing of seeds two irrigations were done during the life cycle of sesame. Excess water was drained out during the irrigation or natural rainfall during the cropping period of the crop.

3.7.5.4. Plant protection measures

During the growth period some plants were infested by Green peach aphid and leafhopper. It was controlled by spraying with Diazinone 60 EC @ 1L ha^{-1} at the time of infested period.

3.8. General observation of the experimental field

The research field looked nice with normal green plants. Field was observed time to time to detect visual difference among the treatment and any kind of infestation by weeds, insects and diseases so that considerable losses by pest was minimized.

3.9. Harvesting and threshing

The crop was harvested on 25 July, 2014. The crop was harvested plot wise when about 80% of the capsules became matured. Plants of 1 m^2 area from the central part of each plot were harvested and tied into bundles and carried to the threshing floor. The bundles were dried in the open sunshine for three consecutive days. The seeds were separated from the pods by beating with the bamboo stick and then cleaned, dried and weight. A weight of dried stover yield was also taken.

3.10. Collection of experimental data

The data were collected on different parameters of sesame plants. Five plants were randomly selected from each plot excluding border plots outside the central $1m^2$ area which was kept for yield. The sample plants were uprooted carefully from the soil with khurpi so that no seeds were dropped into the soil and then cleaned, dried and the data on the following crop characters were collected from those sample plants:

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

A brief outline of the above mentioned parameters of the data recording is given below:

3.10.1. Plant height (cm)

The height of each plant was measured from the base to the tip of the plant at harvest and the mean height was expressed in centimeter.

3.10.2. Number of branches plant^{-1}

The number of branches plant^{-1} was counted from pre-selected five plants and mean values were taken.

3.10.3. Leaf area index (%)

The leaf area was measured using Leaf Area Meter and Leaf Area Index (LAI) was calculated using the formula-

$$\text{Leaf Area Index (\%)} = \frac{\text{Total leaf area}}{\text{Ground area}}$$

Ground area= Spacing (30cm x 5cm)

3.10.4. Dry weight (kg ha^{-1})

The dry weight (DW) was recorded by shade drying the plant samples in air for one hour and then oven dried at 65±5°C till the constant weight was attained and DW was expressed in kg ha^{-1}.

3.10.5. Number of capsule plant^{-1}

The number of capsule plant^{-1} of pre-selected five plants from each unit plot was obtained and mean number was determined. The mean number was determined on per plant basis.

3.10.6. Number of seed capsule^{-1}

From each sample plant of five sampled plants, 10 capsules were randomly selected and all the seeds of them were counted, the number of seed capsule^{-1} was determined by averaging the data.

3.10.7. 1000-seed weight (g)

One thousand cleaned and dried sesame seeds were counted and then the data were recorded by means of an electrical balance and the weight was expressed in grams.

3.10.8. Seed yield (kg ha^{-1})

Weight of seeds of the harvested area (1.0m^2) located at the center of each plot was taken and then converted to the yield in kg ha^{-1}.

3.10.9. Biological yield (kg ha^{-1})

After separation of seed from the crop, the stover was sun dried for three consecutive days and weighed by a digital balance. After that the biological yield was calculated by summing up of seed yield and stover yield form the Biological yield in kg ha^{-1}.

3.10.10. Harvest index (%)

It was counted with the following data-

$$\text{Harvest index (\%)} = \frac{\text{Seed yield}}{\text{Biological yield}} \times 100$$

3.11. Statistical analysis of the data

All the data collected on different parameters were statistically analyzed following the Analysis of Variance (ANOVA) technique and mean differences were adjudged by Least Significant Different Test (Gomez and Gomez, 1984) at 5% level of significance using the MSTAT-C computer package program.

Chapter 4
Results and Discussion

Chapter 4

Result and Discussion

This chapter comprises of the presentation and discussion of the results from the experiment. The data have been presented in tabular and graphical form for the convenience of the reader. The result of each parameter has been discussed and possible interpretations have been made whenever necessary in the following heading and sub-headings:

4.1. Plant height (cm)

4.1.1. Effect of varieties

Effect of varieties on plant height was found significant. Maximum plant height was found in Atshira (96.417 cm) followed by BARI Til 4. Minimum plant height was found for BARI Til 3 (85.17 cm). The effect of varieties on plant height was shown in Table 1. Local varieties of sesame are usually taller as seen in the experiment.

4.1.2. Effect of detopping

Effect of detopping on plant height was found significant and was shown in Figure 1. The maximum plant height (98.77 cm) was found in no detopped plants (D_0). On the other hand the minimum plant height (81.44

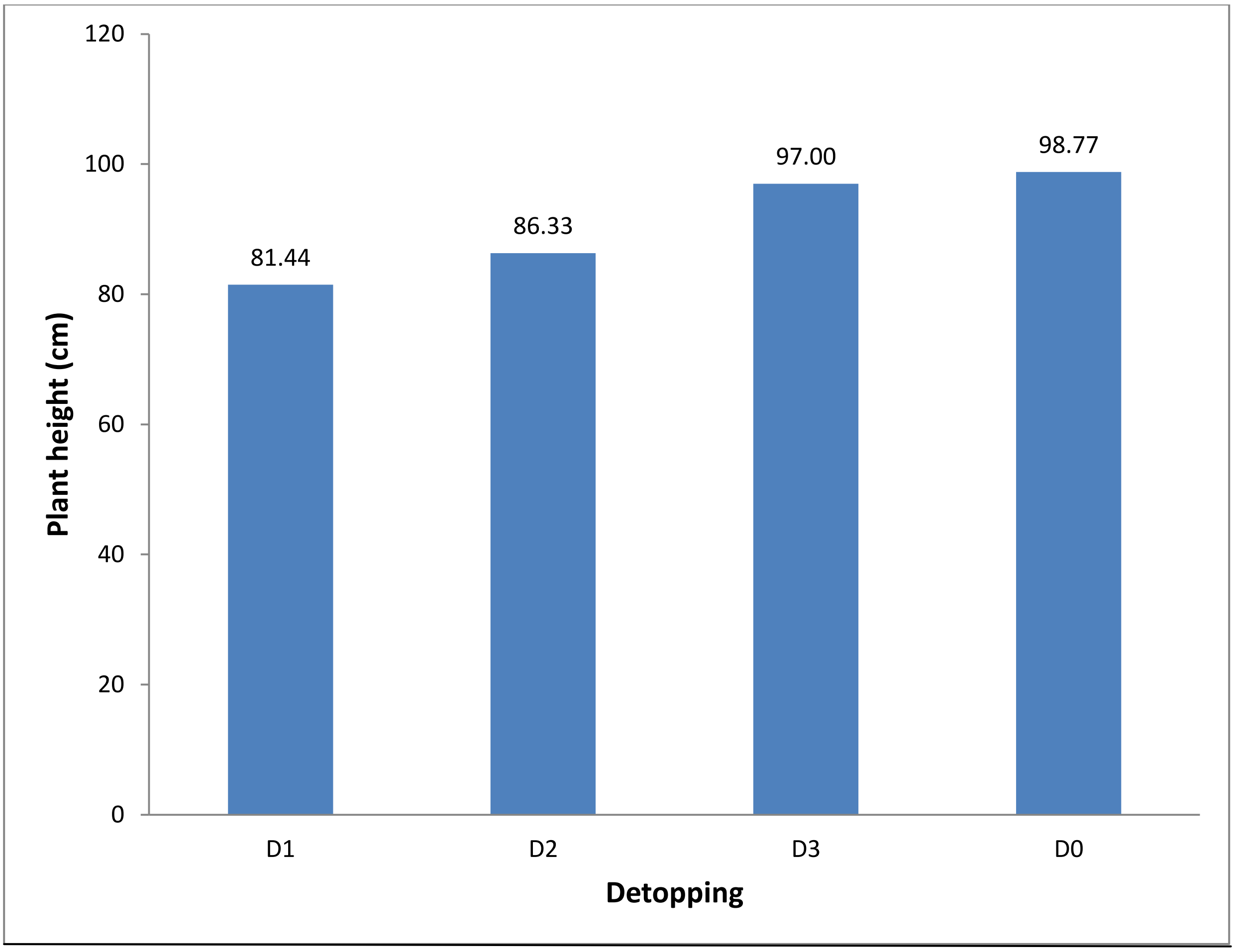
cm) was found in plants detopped at 25 DAS (81.44 cm). Detopping retards the normal growth of the shoot apex and thus maximum height is found for plant without detopping.

4.1.3. Combined effect of varieties and detopping

Combined effect of varieties and detopping on plant height was also significant and was shown in Table 2. Maximum plant height (103.15 cm) was found in Atshira without detopping the plants which was statistically similar with variety Atshira with detopping at 25DAS. Minimum plant height (76 cm) was found in BARI Til 3 when detopped at 35 DAS. The maximum height in control treatment might be attributed to continuous supply of auxin to apical meristematic tissues. This is in accordance with findings of Venkadachalam (2003).

Table 1: Effect of varieties on plant height of sesame

Variety	Plant height
BARI Til 3	85.167 a
BARI Til 4	91.083 b
Atshira (Local)	96.417 c
$LSD_{0.05}$	1.26
CV%	1.64



.

Figure 1: Effect of detopping on plant height (cm) of sesame(LSD$_{0.05}$=1.46)

D_1= Detopping at 25 DAS

D_3= Detopping at 45 DAS

D_2= Detopping at 35 DAS

D_0= Without detopping

Table 2: Combined effect of varieties and detopping on plant height, number of branches plant^{-1}, LAI and 1000-seed weight of sesame

Combination of treatments	Plant height (cm)	No. of branches plant^{-1}	LAI	1000 seed weight (g)
V_1 x D_1	93 d	22 bc	1.05bc	2.13a
V_1 x D_2	76 g	22.66ab	1.02 c	2.19 a
V_1 x D_3	80.67 f	24 a	1.12 ab	2.24 a
V_1 x D_0	91 d	20 de	0.94 de	2.17 a
V_2 x D_1	100.33 b	18 fg	0.77 f	2.23 a
V_2 x D_2	81.33 f	20.66 cd	0.92 de	2.31 a
V_2 x D_3	85.67 e	22.33abc	0.98 cd	2.23 a
V_2 x D_0	97 c	17 g	0.66 g	2.24 a
V_3 x D_1	103 a	19 def	0.93 de	2.18 a
V_3 x D_2	87 e	22.33abc	1.15 a	2.28 a
V_3 x D_3	92.67 d	22.33abc	1.14 a	2.26 a
V_3 x D_0	103.15 a	18.66efg	0.90 e	2.16 a
$LSD_{0.05}$	1.46	1.82	0.07	0.19
CV%	1.64	3.54	4.62	5.22

Similar letter within the parenthesis do no differ significantly at 5% level of significance according to Duncan's Multiple Range Test

V_1= BARI Til 3
V_2 = BARI Til 4
V_3 = Atshira (Local)

D_1= detopping at 25 DAS
D_2 = detopping at 35 DAS
D_3 = detopping at 45 DAS
D_0= without detopping

4.2. Number of branches plant^{-1}:

4.2.1. Effect of variety

Difference in number of branches plant^{-1} was found significant for different varieties (Table 3). Maximum number of branches plant^{-1} was found from BARI Til 3 (22.17) followed by 20.58 from BARI Til 4. Minimum number of branches plant^{-1} was found in Atshira (19.5).

Table 3: Effect of varieties on number of branches plant^{-1} of sesame

Variety	Number of branches plant^{-1}
BARI Til 3	22.17 a
BARI Til 4	20.58 b
Atshira (L)	19.5 c
$LSD_{0.05}$	0.92
CV%	3.54

4.2.2. Effect of detopping

Effect of detopping on number of branches plant^{-1} was found significant (Figure 2). Maximum number of branches plant^{-1} (22.889) was found for detopping at 35 DAS followed by detopping at 25 DAS. Minimum number of branches plant^{-1} (18.556) was found when detopped at 45 DAS. Imayavaramban *et al.* (2004) also found more number of branches with manual clipping of leaves.

4.2.3. Interaction effect of variety and detopping

Effect of combination of variety with detopping on number of branches plant^{-1} was found significant (Table 1). Maximum number of branches plant^{-1} (24) was found for BARI Til 3 when detopped at 45 DAS. Minimum number of branches per plant (17) was found for BARI Til 4 with no detopping. Similar results were reported by Sarkar and Pal (2005) and Tewolde *et al.* (1994).

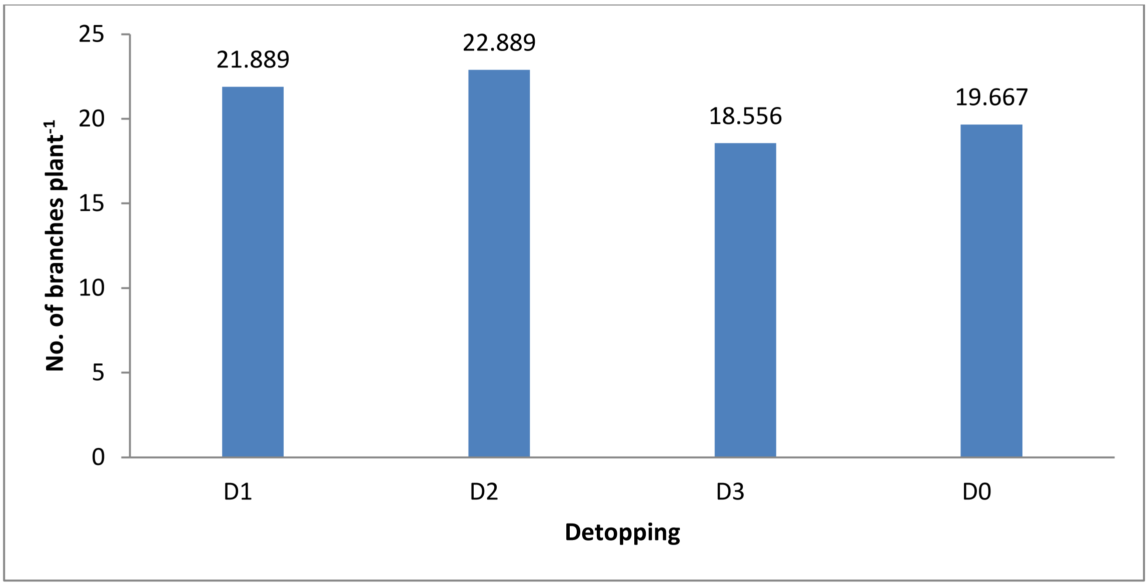


Figure 2: Effect of detopping on number of branches plant^{-1} ($LSD_{0.05}$=1.05)

D_1= Detopping at 25 DAS

D_2= Detopping at 35 DAS

D_3= Detopping at 45 DAS

D_0= Without detopping

4.3. Leaf Area Index

4.3.1. Effect of variety

Effect of variety on leaf area index was found significant. Results have been shown in Table 4. Maximum LAI was found for BARI Til 3(1.034) followed by variety Atshira (1.033). It may be due to enhanced number of leaves and large sized leaves of BARI Til 3 and also the more of branch plant^{-1} than the other varieties. Minimum LAI was found for BARI Til 4 (0.836)

Table 4: Effect of variety on LAI of sesame

Variety	LAI
BARI Til 3	1.034 a
BARI Til 4	0.836 b
Atshira	1.033 a
$LSD_{0.05}$	0.04
CV%	4.62

4.3.2. Effect of detopping

Effect of detopping on LAI was found significant in sesame. Maximum LAI (1.08) was found for D_2 (detopping at 35 DAS) and that of the minimum value (0.84) was found for detopping at 45 DAS. Results have been showed in Figure 3. Detopping at the active growing of the plant produced more branches and leaf and which resulted in more leaf area.

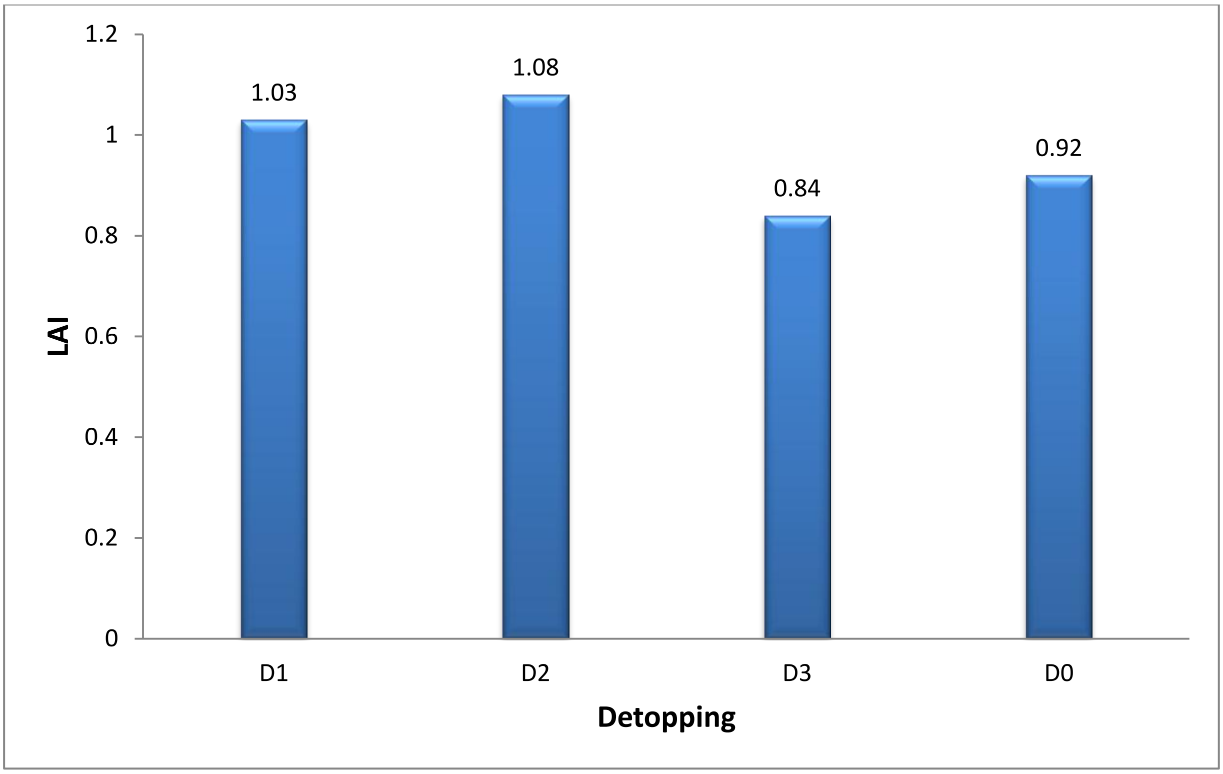


Figure 3: Effect of detopping on LAI of sesame ($LSD_{0.05}$ = 0.04)

D_1= Detopping at 25 DAS

D_2= Detopping at 35 DAS

D_3= Detopping at 45 DAS

D_0=Without detopping

4.3.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant for LAI. Maximum value (1.15) was found for Atshira when detopped at 35 DAS. Minimum LAI (0.66) was found for BARI Til 4 in combination with control detopping. Results have been shown in Table 2. These results are in conformity with Kokilavani *et al*. (2007).

4.4. Number of capsule plant^{-1}

4.4.1. Effect of varieties

Effect of varieties on number of capsule per plant was found significant. Maximum number of capsule /plant was found in variety BARI Til 3 (101.92) followed by variety Atshira (L). Minimum number of capsule/plant was found from variety BARI Til 4 (65) (Table 5). Increased number of leaves and branches of BARI Til 3 produced higher amount of assimilates and it may be reason of more number of capsule plant^{-1}.

4.4.2. Effect of detopping

Effect of detopping on number of capsule plant^{-1} was found significant. Maximum value (102.11) was found in D_2 (detopping at 35 DAS) followed by D_1 (detopping at 25 DAS). Minimum value (71.33) was found for D_0 (detopping at 35 DAS) (Table 6). Similar results have been found by Sing *et al.* (2013).

4.4.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant on number of capsule per plant. Maximum value was found in BARI Til 3 combined with detopping at 35 DAS. Minimum numbers of capsules per plant were found from BARI Til 4 in combination with detopping at 35 DAS (Table11). These results are in conformity with Sing *et.al.* (2013) who found higher yield in topped plant with varying amount of Nitrogen.

Table 5: Effect of variety on number of capsule $plant^{-1}$

Variety	number of capsule $plant^{-1}$
V_1	101.92 a
V_2	65 c
V_3	96.92 b
$LSD_{0.05}$	2.13
CV%	2.86

V_1= BARI Til 3

V_2= BARI Til 4

V_3= Atshira (Local)

Table 6: Effect of detopping practice on number of capsule plant^{-1}

Detopping	number of capsule plant^{-1}
D_1	102.11 a
D_2	91.89 b
D_3	86.44 c
D_0	71.33 d
$LSD_{0.05}$	2.45
CV%	2.86

D_1= Detopping at 25 DAS

D_2= Detopping at 35 DAS

D_3= Detopping at 45 DAS

D_0= Without detopping

4.5. 1000 seed weight (gm)

4.5.1. Effect of varieties

Effect of varieties on 1000-seed weight of sesame was not found statistically significant. However, maximum1000-seed weight (2.26) was produced in BARI Til 4 followed by Atshira (L). Minimum weight of 1000 seed (2.19) was found in BARI Til 4 (Figure 4). It may be due to the course grain of BARI Til 4.

4.5.2. Effect of detopping

Effect of detopping on 1000-seed weight of sesame was not found statistically significant but maximum 1000-seed weight (2.26) was found in D_1 (detopping at 25 DAS) followed by D_2 (detopping at 35 DAS) of sesame plants. Minimum value (2.18) was found for D_0 (no detopping). The latter the detopping was done the lower the 1000 seed weight was found (Figure 5). Sing *et.al.* (2013) also found similar results.

4.5.3. Combined effect of variety and detopping

Combined effect of variety and detopping was not found significant on 1000 seed weight of sesame. Maximum value (2.31) was found for BARI Til 4 combined with detopping at 35 DAS. Minimum 1000 seed weight (2.13) was found for BARI Til 3 in combination with detopping at 25DAS (Table 2).

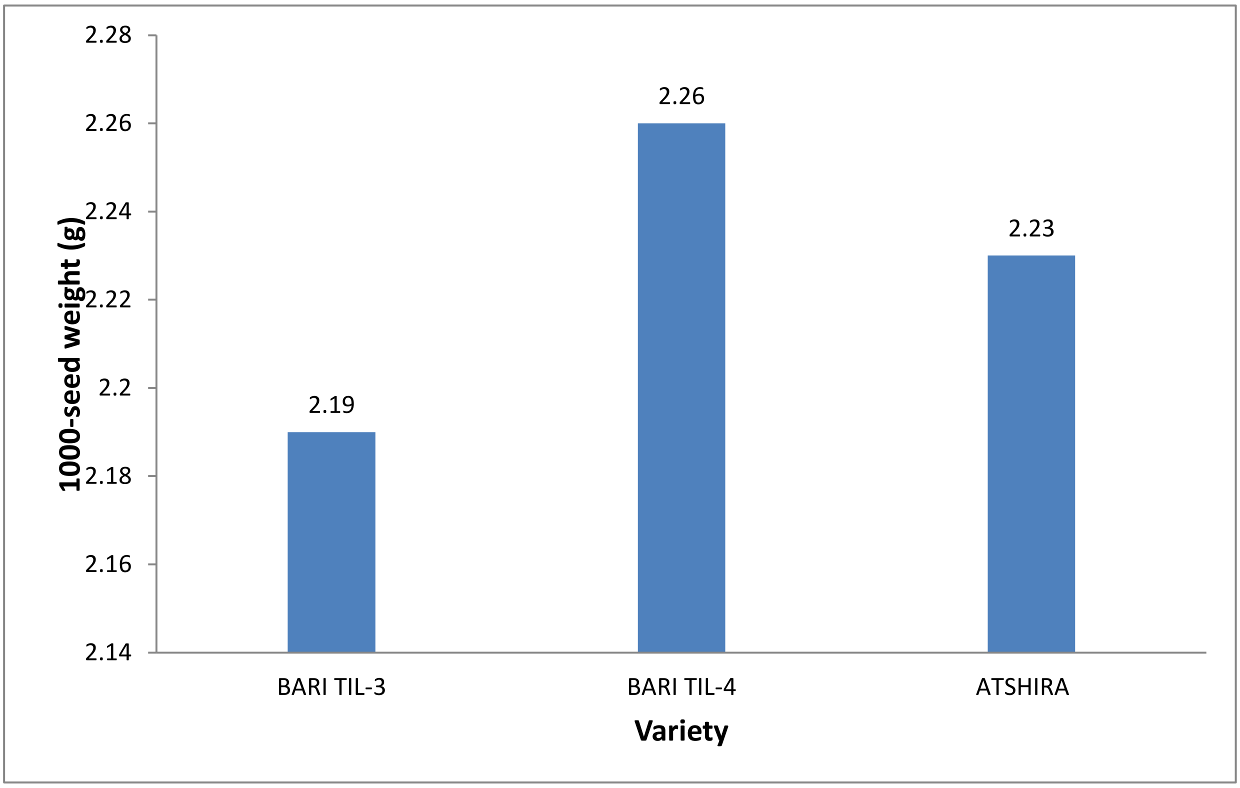


Figure 4: Difference in 1000-seed weight for varietal difference ($LSD_{0.05}$= 0.0989)

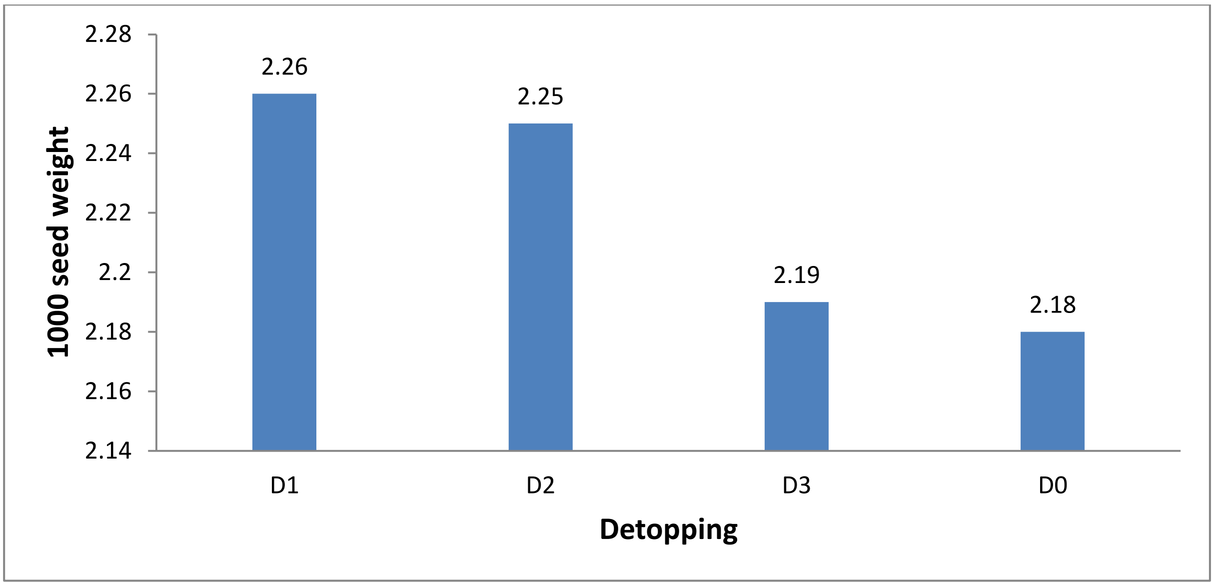


Figure 5: Difference in 1000-seed weight for detopping at different stages ($LSD_{0.05}$= 0.1142)

D_1=Detopping at 25 DAS

D_2=Detopping at 35 DAS

D_3=Detopping at 45 DAS

D_0= Without detopping

4.6. Number of seeds capsule^{-1}:

4.6.1. Effect of varieties

Effect of varieties on number of seed capsule^{-1} of sesame was found significant. Maximum seed capsule^{-1} was found for variety BARI Til 3 (32.88) followed by BARI Til 4. Minimum number of seed capsule^{-1} was found in Atshira (31.65) (Table7). It may be due to the comparatively taller pod of BARI Til 3.

4.6.2. Effect of detopping

Effect of detopping on number of seed capsule^{-1} of sesame was found significant. Maximum value (33.62) was found for D_0 (no detopping) followed by D_2 (detopping at 35 DAS). Minimum value (30.77) was found for D_3 (detopping at 45 DAS) (Table 8).

4.6.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant on number of seed capsule^{-1} of sesame. Maximum seed capsule^{-1} (35.2) was found for Atshira (L) combined with no detopping. Minimum number of seed capsule^{-1} (28.8) was found for BARI Til 4 when detopped at 45 DAS (Table 11).

Table 7: Difference in number of seed capsule^{-1} of sesame for varietal difference

Variety	Number of seed capsule^{-1}
BARI Til 3	32.88
BARI Til 4	32.217
Atshira (L)	31.65
$LSD_{0.05}$	1.50
CV%	5.34

Table 8: Difference in number of seed capsule^{-1} of sesame for detopping at different stages

Detopping	Number of seed capsule^{-1}
D_1	32.22
D_2	32.37
D_3	30.77
D_0	33.62
$LSD_{0.05}$	1.68
CV%	5.34

D_1= Detopping at 25 DAS

D_2= Detopping at 35 DAS

D_3= Detopping at 45 DAS

D_0=Without detopping

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

4.7.1. Effect of varieties

Effect of varieties on seed yield of sesame was found significant. The highest seed yield (1013.5kg ha^{-1}) was found in BARI Til 3 followed by Atshira (Local). Minimum seed yield was found in BARI Til 4 (826.7 kg ha^{-1}). Results were shown in (Table 9). Higher number of seed capsule^{-1} and capsule plant^{-1} resulted in higher seed yield.

4.7.2. Effect of detopping

Effect of detopping on seed yield of sesame was found significant. Maximum value (1126.6 kg ha^{-1}) was found for D_3 (detopping at 45 DAS) followed by D_2 (detopping at 35 DAS) (Table 10). Minimum value (787.2) was found for D_0 (without detopping).Effect of terminal clipping on yield attributes was also reported by Imayavaramban (2000). Clipping at 45 DAS recorded maximum seed yield. This may be due to induction of more number of lateral branches per plant**.**

4.7.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant on seed yield of sesame. Maximum value was found for BARI Til 3 combined with detopping at 35 DAS (1183.3 kg ha^{-1}). Minimum seed yield (876.3 kg ha^{-1}) was found for BARI Til 4 in combination with no detopping.

Results were shown in Table 11. The increase in seed yield of sesame in topped plants over non topped plants was due to increase in more number of branches per plant and capsules per plant. Venkadachalam (2003) also found similar results. Imayavaramban *et al*. (2004) and Kokilavani *et al*. (2007) also found similar results in sesame.

4.8. Dry matter production (kg ha^{-1})

4.8.1. Effect of variety

Dry matter production was found significantly different in different varieties. Maximum value was found from BARI Til 3 (3267.1kg ha^{-1}) followed by variety Atshira (L). Minimum value was found for BARI Til 4 (2842.5 kg ha^{-1}) (Figure 6). Higher amount of dry matter production may be due to the higher amount of branches and leaves of BARI Til 3.

4.8.2. Effect of detopping

Effect of detopping on dry matter production of sesame was found significant. Maximum value (3360 kg ha^{-1}) was found for D_2 (detopping at 35 DAS) followed by D_1 (detopping at 25 DAS). Minimum value (2869 kg $ha^{-1)}$ was found for D_3 (detopping at 45 DAS). Results have been shown in Figure 7. Detopping at active growth may be reason of increased dry matter production.

4.8.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant on dry matter production of sesame. Maximum value (3648.7 kg ha^{-1}) was found for BARI Til 3 when detopped at 35 DAS. Minimum value (2730 kg ha^{-1}) was found for BARI Til 4 (2730 kg ha^{-1}) in combination with no detopping.

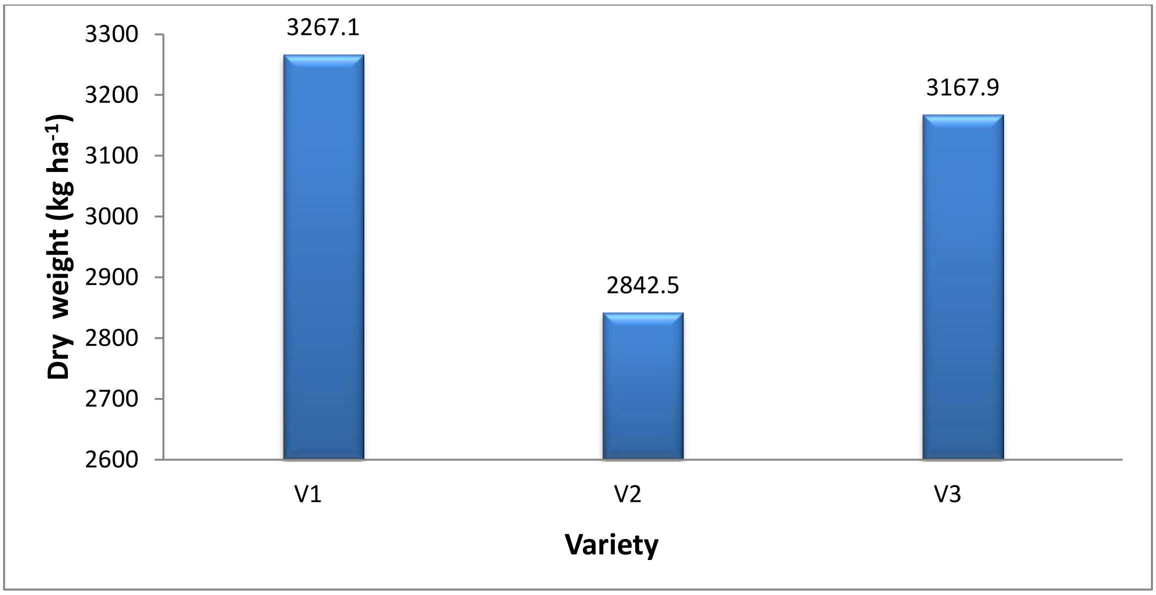


Figure 6: Effect of variety on dry weight (kg ha^{-1}) of sesame ($LSD_{0.05}$=211.14)

V_1 = BARI Til 3

V_2 = BARI Til 4

V_3 = Atshira (L)

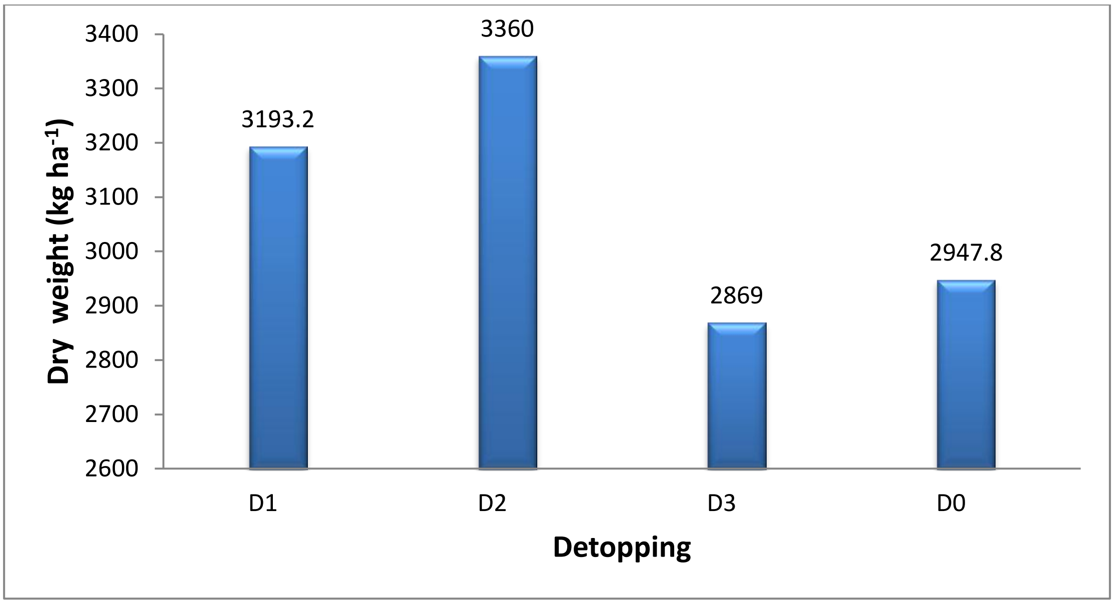


Figure 7: Effect of detopping on dry weight (kg ha^{-1}) of sesame ($LSD_{0.05}$=166.02)

D_1= detopping at 25 DAS
D_2= detopping at 35 DAS
D_3= detopping at 45 DAS
D_0= without detopping

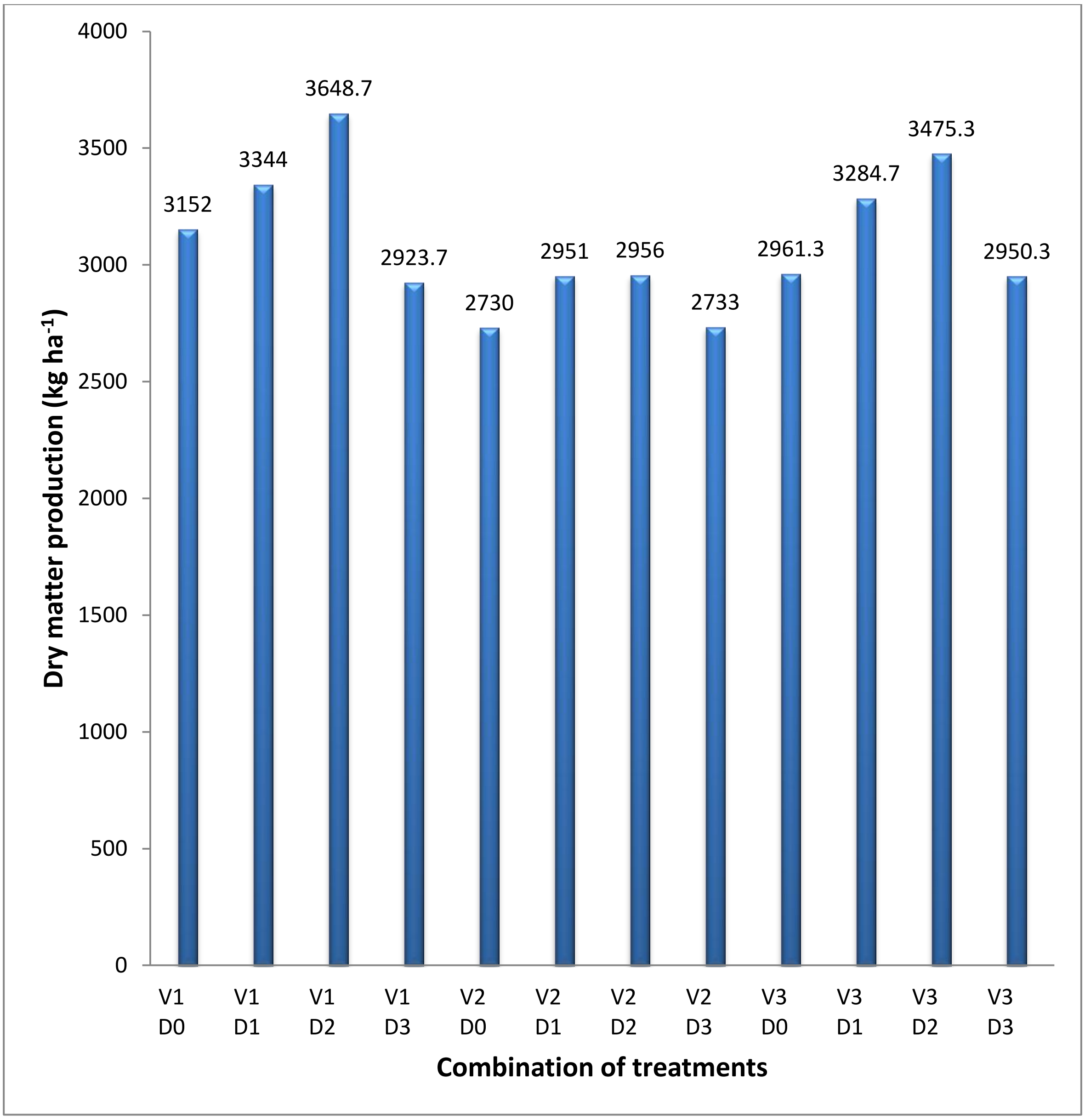


Figure 8: Combined effect of variety and detopping on dry matter production (kg ha^{-1}). ($LSD_{0.05}$=103.44)

V_1= BARI Til 3

V_2= BARI Til 4

V_3=Atshira (L)

D_1= detopping at 25 DAS

D_2= detopping at 35 DAS

D_3= detopping at 45 DAS

D_0= without detopping

4.9. Biological yield (kg ha^{-1})

4.9.1. Effect of varieties

Effect of varieties on biological yield of sesame was found significant. Maximum biological yield was found in Atshira (2620 kg ha^{-1}) followed BARI Til 3 (2197 kg ha^{-1}). Minimum biological yield was found in BARI Til 4 (2106 kg ha^{-1}) (Table 9). It may be attributed to the height of this local variety.

4.9.2. Effect of detopping

Effect of detopping on biological yield of sesame was found significant. Maximum value was found for D_1 (detopping at 25 DAS) (2580.3 kg ha^{-1}) followed by D_0 (without detopping). Minimum value (2026.7 kg ha^{-1}) was found for D_3 (detopping at 45 DAS)(Table 10). Detopping at an early age produced more branches which may be cause of such result.

4.9.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant on biological yield of sesame. Maximum value (2866.4 kg ha^{-1}) was found in Atshira (L) combined with D_0 (without detopping). Minimum seed yield (1854.6 kg ha^{-1}) was found in BARI Til 3 in combination with D_3 (detopping at 45 DAS).(Table 11)

4.10. Harvest index(%)

4.10.1. Effect of varieties

Effect of varieties on harvest index of sesame was found significant. Maximum harvest index (46.19%) was found for BARI Til 3 followed by BARI Til 4. Minimum harvest index was found in Atshira (38.85%) (Table 9). Higher seed yield of BARI Til 3 resulted in higher harvest index.

4.10.2. Effect of detopping

Effect of detopping on harvest index of sesame was found significant. Maximum value (49.17%) was found for plants detopped at 35 DAS followed by plants detopped at 45 DAS. Minimum value (38.70%) was found for D_0 (without detopping) (Table 10).

4.10.3. Combined effect of variety and detopping

Combined effect of variety and detopping was found significant on harvest index of sesame. Maximum value (50.467%) was found for BARI Til 3 when detopped at 35 DAS. Minimum Seed yield (34.63%) was found in Atshira combination with D_0 (without detopping) (Table 11)

Table 9: Effect of variety on some yield attributes of sesame

Treatment	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
BARI Til 3	1013.5 a	2197 b	46.19 a
BARI Til 4	826.7 b	2106 b	39.35 b
Atshira	1008.5 a	2620 a	38.85 b
$LSD_{0.05}$	17.51	124.2	3.45
CV%	0.93	6.84	5.68

Table 10: Effect of detopping on some yield attributes of sesame

Treatment	Seed yield (kg ha$^{-1)}$	Biological yield (kg ha$^{-1)}$	Harvest index (%)
D_1	888.8 c	2580.3 a	38.74 b
D_2	995.8 b	2292.2 c	49.17 a
D_3	1126.6 a	2026.7 d	39.24 b
D_0	787.2 d	2332.9 b	38.70b
$LSD_{0.05}$	8.67	17.7	5.25
CV%	0.93	6.84	5.68

D_1= detopping at 25 DAS

D_2= detopping at 35 DAS

D_3= detopping at 45 DAS

D_0= without detopping

Table 11: Combined effect of variety and detopping on no. of capsule plant^{-1}, seed capsule^{-1}, seed yield, biological yield and harvest index of sesame

Treatment	No. of capsule plant^{-1}	No. of seed capsule^{-1}	Seed yield (kgha^{-1})	Biological yield(kg ha^{-1})	Harvest index(%)
V_1 x D_0	102.33 c	31.2 bcd	939 d	2097.8 cd	44.767 bc
V_1 x D_1	110 b	33.867 ab	1066.7 b	2490.2 b	42.867 c
V_1x D_2	116.67 a	32.4 abc	1183.3 a	2347.4 bc	50.467 a
V_1 x D_3	92.67 de	34.067 ab	934.3 de	1854.6 d	46.667 abc
V_2 x D_0	68.33 h	34.467 a	876.3 f	2034.6 d	36.687 d
V_2 x D_1	90.33 ef	29.4 d	951.3 d	2407.4 b	36.767 d
V_2 x D_2	82.33 g	33.933 ab	1028 bc	2112.7 cd	48.7 ab
V_2 x D_3	64.67 h	28.8 d	887.7 ef	1870.2 d	35.267 d
V_3 x D_0	98.33 cd	35.2 a	983 cd	2866.4 a	34.633 d
V_3 x D_1	98.67 c	33.4 abc	1039.7 b	2843.2 a	36.6 d
V_3 x D_2	111 ab	30.8 cd	1074.3 b	2416.6 b	48.367 ab
V_3 x D_3	85.67 fg	29.467 d	876.0 f	2355.2 bc	35.8 d
$LSD_{0.05}$	5.73	2.92	49.64	86.70	6.24
CV%	2.86	5.34	0.93	6.84	5.68

Similar letter within the parenthesis do no differ significantly at 5% level of significance according to Duncan's Multiple Range Test

V_1= BARI Til 3
V_2 = BARI Til 4
V_3 = Atshira (L)

D_1= detopping at 25 DAS
D_2= detopping at 35 DAS
D_3= detopping at 45 DAS
D_0= without detopping

Chapter 5

Summary and Conclusion

Chapter 5

Summary and Conclusion

The research experiment was conducted at the field research farm of Agronomy, Sher-e-Bangla Agricultural University, Dhaka during the period from 10 April to 25 July, 2014 to determine “Effect of detopping on growth and yield of sesame”. This experiment comprised of two factors namely varieties viz. BARI Til 3, BARI Til 4, Atshira and detopping at four stages viz. Detopping at 25 DAS, Detopping at 35 DAS, Detopping at 45 DAS and without Detopping. The experiment was laid out in Randomized Complete Block Design (RCBD) comprising three replications in 12 treatments combination. The unit plot size was 3m x 2m and fertilizers were applied as per the recommended dose.

The data were recorded on the basis of sesame plant height (cm), number of branches plant^{-1}, Leaf Area Index (LAI), 1000-seed weight (g), number of capsule plant^{-1}, number of seed capsule^{-1}, seed yield (kg ha^{-1}), dry weight (kg ha^{-1}), biological yield (kg ha^{-1}) and Harvest Index (%). Data were analyzed using MSTAT-C software package program. The mean differences among the treatments were compared by Least Significant Different Test at 5% level of significance.

The present finding showed detopping practice in different varieties had a significant role on most of the growth and yield attributes of sesame.

No definite variety was superior in all the growth and yield parameters. Rather different varieties showed promising results in different parameters. But BARI Til 3 was found superior in most of the cases. Maximum plant height and Biological yield was found in Atshira (L) whereas 1000-seed weight was found maximum in BARI Til 4.In all the other cases (number of branches plant^{-1}, Leaf Area Index , dry weight, number of capsule plant^{-1}, number of seeds capsule^{-1}, seed yield and Harvest Index) BARI Til 3 was found superior.

No definite stage of detopping was superior in all the growth and yield parameters. Rather different stages showed promising results in different parameters. But detopping at 35 DAS was found superior in most of the cases. Plant height and number of seed per capsule was found maximum for D_0 (without detopping). Maximum LAI was found for detopping at 45 DAS. 1000-seed weight and Biological weight was maximum for detopping at 25 DAS. In all the other cases i.e. number of branches plant^{-1}, dry weight of the plant, number of capsule plant^{-1}, seed yield and Harvest Index were highest for detopping at 35 DAS.

Combination of BARI Til 3 when detopped at 35 DAS was found superior in most of the cases. Plant height and number of seed capsule^{-1} and biological yield was found maximum for the combination of Atshira with no detopping. Number of branches plant^{-1} was maximum for BARI Til 3 when detopped at 45 DAS. Maximum LAI was found for variety Atshira (L) in combination with detopping at 35 DAS. 1000- seed weight was maximum for BARI Til 4 in combination with detopping at 25 DAS. In all other cases i.e. dry weight, number of capsule plant^{-1} and most importantly yield (seed yield) and Harvest Index (%) was found maximum for detopping at 35 DAS of BARI Til 3.

At the end of the above results and discussions it can be conclude that-

- Among the varieties BARI Til 3 showed more promising results in this practice
- Detopping at 35 DAS showed more promising results in case of growth and yield
- BARI Til 3 in combination with detopping at 35 DAS showed more promising results in case of growth and yield of sesame

References

References

Anderson, E. (1960). The evolution of domestication, Evolution after Darwin, In Sol Tax (ed.), Vol II. Univ. Chicago Press, Chicago. p. 67-84.

Argall, J. F. and Stewart, K. A. (1984).Effects of Decapitation and Benzyladenineon Growth and Yield of Cowpea [*Vigna unguicuiata* (L.)Walp.]. *Annals of Botany*. **54**: 439-444.

Ashri, A. (2007). Genetics Resources, Chromosome Engineering, and Crop Improvement. Vol. IV, CRC Press, Boca Raton, FL, USA. p. 125.

Bahrami, H. and Razmjo, J. (2012).Effect of salinity stress (NaCl) on germination and early seedling growth of ten sesame cultivars (*Sesamum indicum* L.). *Intl. J. Agric. Sci.* **2**(6): 529–537.

Bailey, L. H. (1949). Manual of cultivated plants. Revised Second Ed. Macmillan & Co., New York. p. 1116.

BBS. (2004). Monthly Statistical Bulletin Of Bangladesh (December). Bangladesh Bureau Of Statistics, Statistics Division, Ministry Of Planning, Govt. Peoples Republic Of Bangladesh, Dhaka.

Bedigian, D. (2003). Evolution of Sesame Revisited: Domestication, Diversity and Prospects. *Genet. Resour. Crop Evol.***50**: 779-787.

Bedigian, D. (2011). Evolution of sesame revisited: domestication, diversity and prospects. *Genet. Resour. Crop Evol.***50**: 779-787

Bedigion, D. (2004).History and lore of Sesame in South-East Asia. *Econ. Bot.,***58** (3): 329-353.

Benner, B. L. (1988). Effects of apex removal and nutrient supplementation on branching and seed production in *Thlaspi arvense* (Brassicaceae).*American J. Bot.* **75**(5): 645-651. 1988.

Bruce, E. A. (1953a). Notes on African Pedaliaceae. *Kew Bull.***67**: 417-429.

Cline, M. G. (1997). Concepts and Terminology of Apical Dominance. *American J. Bot.* **84**(9): 1064–1069.

De Candolle, A. (1886). Origin of cultivated plants. Kegan Paul, French Co., London. Reprinted by Noble Offset Printers, New York. 1959.

Esquinas-Alcazar, J. (2004). International Treaty on Plant Genetic Resources for food and agriculture. *Pl Gen. Res. for Food and Agric.***134**: 1-6.

Food and Agricultural Organization. (2003). Land Resources Appraisal of Bangladesh. Department Report-2. Food and Agricultural Organization, Rome, Italy. p .125

Fluckiger, F.A. and Hanbury. (1879). *Pharmographica*-A history of the principal drugs of vegetable origin met within Grest Britain and British India. Macmillan & Co. London.

Fuller, D.Q. (2003). Further Evidence on the Prehistory of Sesame. *Asian Agr-History J*.**7**: 127-137.

Gomez, K. A. and Gomez, A. A. (1984).Statistical procedure for agricultural research. John Willey and Sons, New York. pp. 97-411.

Ihlenfeldt, H.D. and Grabow-Seidensticker, U. (1979). The Genus *Sesamum* L. and the Origin of the Cultivated Sesame. In: Kunkel, G., Ed., Taxonomic Aspects of African Economic Botany: Proceedings of the IX Plenary Meeting of A.E.T.F.A.T., 18-23 March 1978, Las Palmas de Gran Canaria, p. 53-60.

Imayavaramban, V., Panneerselvam, P., Isaac Manuel, R. and Thabuthan, K. (2004).Effect of differentnitrogen levels, clipping and growth regulators onthe growth and yield of sesame. *Sesame Safflower Newsl.***19**: 40-44.

Khidir, O.M., Osman, H.G. (1970). Correlation studies of some agronomic characters in sesame. *Exp. Agric*. 6(1): 27-31.

Kokilavani, R. S., Jagannathan, Selvaraju, R. and Thavaprakaash, N. (2007).Influence of Terminal Clipping on Growth and Yield of Sesame Varieties. *Asian J. Agric. Res.***1**: 142145

Kumar, S. and Goel, P. D. (1994)**.** A great ancient oilseed sesamum. *Farmer and Parliament.* **12** : 6-7.

Kumaresan, D. and Nadarajan, N. (2002). Association of yield with some biometrical and physiological characters over different environments in sesame (*Sesamum indicum* L.). Sesame and Safflower Newsletter, No. 17. Institute of Sustainable Agriculture (IAS), CSICApartado 4084 – Córdoba, Spain.

Langham, D. R., Riney, J., Smith, G. and Wiemers, T. (2008). Sesame grower guide.Sesaco Sesame Coordinators, Lubbock, TX.

Morris, J.B. (2002). Food, industrial, nutraceutical, and pharmaceutical uses of sesame genetic resources. **In**: J. Janick and A. Whipkey, (ed.), Trends in new crops and new uses. ASHS Press, Arlington, VA. p. 153–156.

Naber, A. C. and Aarssen, L. W. (1998). Effects of shoot apex removal and fruit herbivory on branching, biomass and reproduction in *Verba* *scumthapsus* (Scrophulariaceae). *The American Midland Nat.* **140**(1): 42-54.

Nayar, N.M., Mehra, K.L. (1970).Sesame - Its Uses, Botany, Cytogenetics, and Origin. *Econ. Bot*. **24**: 20-31.

Ramanathan, S. P. and Chandrashekharan, B. (1998)**.** Effectof nipping, plant geometry and fertilizer on summer sesame (*Sesamum indicum L.*). *Indian. J. Agron.* **43**:329-332.

Rendle, A. B. (1963). The classification of flowering plants. Vol. II. Cambridge University Press, Cambridge.

Sachs, T. (1991). Pattern formation in plant tissues. Cambridge University Univ. Press, Cambridge. p. 640.

Sarkar, R.K. and Pal, P.K. (2005). Effect of crop geometry, fertility level and nipping on physiological parameters in relation to productivity of sesame (*Sesamum indicum*). *Indian J. Agric. Sci.* **75**: 143-146.

Sheahan, C.M. (2014). Plant guide for sesame (*Sesamum orientale*). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center, Cape May, NJ.

Singh, B., Singh, S., Kumar, V. and Kumar, Y. (2013). Nitrogen and nipping schedule for higher productivity of sesame (*Sesamum* *indicum* L.) on aridisols of South - Western Haryana. *Haryana J. Agron.***29** (1 & 2) : 1-5.

Singh, B., Singh, S., Kumar, V. and Kumar, Y. (2003). Nitrogen and nipping schedule for higher productivity of sesame (*Sesamum indicum* L.) on arid isols of South – Western Haryana. *Haryana J. Agron.* **29**(1 & 2) : 1-5.

Steeves, T. and Sussex, I. (1989). Patterns in plant development. Cambridge University Press, New York, NY.

Tamas, I. (1987). Hormonal regulation of apical dominance. **In**: Plant hormones and their role in plant growth and development, Martinus Nijhoff, Boston, MA. p. 393–410.

Ukaan, S. and Ogbonna, P. (2012). Genetic variabilty and caracter association of sesame (*Sesamum indicum* L.) accessions. *Intl. J. Of Pl. Breed.* **6**(2),139-143.

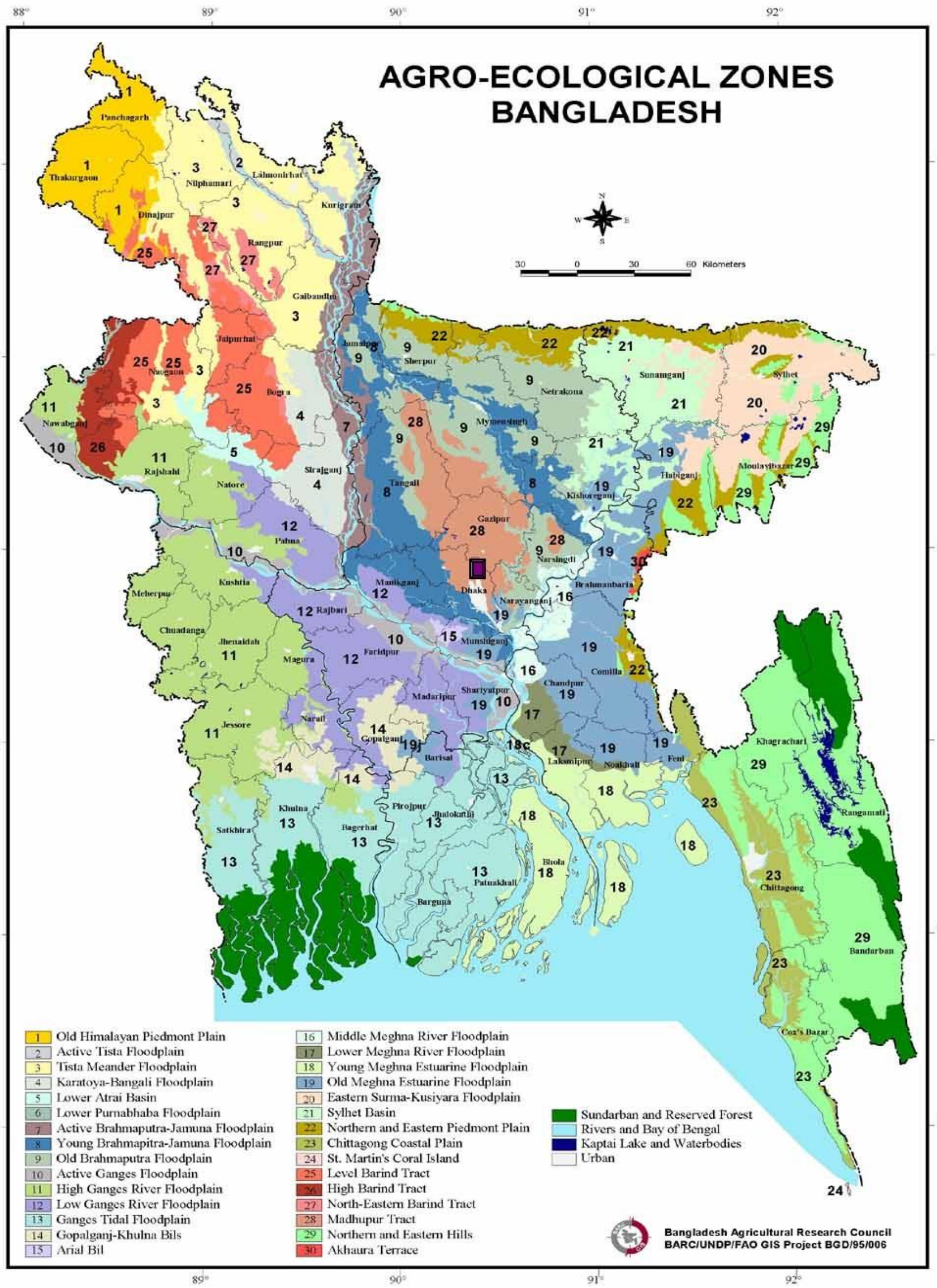
Venkadachalam, K., 2003. Response of sesame cultivars to crop geometry and clipping management in tail end of cauvery delta zone. M. Sc. Thesis, Tamil Nadu Agricultural University, Coimbatore.

Watt, G. (1893). Dictionary of the economic products of India.Govt. India Central Printing Office, Calcutta. p. 502-541.

Yingzhong, Z. and Yishou, W. (2002). Genotypic correlations and path coefficient analysis in sesame. *Sesame and Safflower Newsletter*.No. 17. Institute of Sustainable Agriculture (IAS), CSIC Apartado 4084 – Córdoba, Spain.

Appendices

Appendix I: Experimental Location on the map of Agro- ecological zones of Bangladesh.



Appendix II: Characteristics of soil of experimental site is analyzed by Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka

Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Experimental field, SAU, Dhaka
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

Physical and chemical properties of the initial soil

Characteristics	Value
%Sand	27
%Silt	43
%clay	30
Textural class	Silt-clay
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.077
Available P (ppm)	20.00
Exchangeable K (me/100 g soil)	0.10
Available S (ppm)	45

Source: SRDI, 2014

Appendix III : Monthly average of Temperature, Relative humidity, total Rainfall and sunshine hour of the experiment site during the period from July 2014 to December 2014

Month(2013)	Air temperature (^oC)		Relative humidity (%)	Rainfall (mm)
	Maximum	Minimum		
June	35.4	22.5	80	577
July	36	24.6	83	563
August	36	23.6	81	319
September	34.8	24.4	81	279
October	26.5	19.4	81	22

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka-1212.

Appendix III. ANOVA I

Source of variance	Mean square					
	df	Plant height	Number of branches plant^{-1}	LAI	No. of capsule plant^{-1}	No. of seed capsule^{-1}
Replication	2	54.11	0.012	0.004	0.53	3
Variety	2	380.02**	2.654**	0.156**	4813.03**	4.57**
Detopping	3	628.59**	4.762**	0.109**	1483.3**	12.2**
Variety x Detopping	6	2.73**	0.215**	0.01**	51.32**	19.71**
Error	22	2.237	0.022	0.002	6.32	2.96
Total	35					
CV%		1.64	3.58	4.62	2.86	5.34

** Significant at 1% level

* Significant at 5% level

NS- Non Significant

Appendix IV. ANOVA II

Source of variance	Mean sqare					
	df	1000-seed weight	Seed yield (kg ha^{-1})	Dry matter production (Kg ha^{-1})	Biological yield (Kg ha^{-1})	Harvest index (%)
Replication	2	0.00489	2	0.075	7868	1.081
Variety	2	0.01402^{NS}	135867**	1.87**	902894**	201.79**
Detopping	3	0.01352^{NS}	190535**	1.428**	462497**	238.467**
Variety x Detopping	6	0.00403^{NS}	1746**	0.045**	73424**	16.848**
Error	22	0.0136	79	0.039	2494	5.556
Total	35					
CV%		5.26	0.93	1.42	6.84	5.68

** Significant at 1% level

* Significant at 5% level

NS- Non Significant