

**EFFECT OF SOWING METHOD AND NITROGEN RATE
ON GROWTH AND YIELD PERFORMANCE OF SESAME
IN A SALINE SOIL OF SOUTHWESTERN
COASTAL BANGLADESH**

A THESIS

BY

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STUDENT ID: MS 230805



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the Requirements for the Degree of Master of Science**

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EFFECT OF SOWING METHOD AND NITROGEN RATE ON GROWTH AND YIELD PERFORMANCE OF SESAME IN A SALINE SOIL OF SOUTHWESTERN COASTAL BANGLADESH

Abstract

A field experiment was conducted at the Regional Inspection Centre (RIC), Bangladesh Meteorological Department, Gollamari, Khulna to study the effect of sowing methods and nitrogen rates on the growth and yield attributes of sesame (BARI Til-6). The experiment comprised of three methods of sowing viz. broadcasting, line sowing and dibbling and four nitrogen levels viz. 0, 15, 30 and 45 kg ha⁻¹ as treatments variables. The experiment was conducted in a Randomized Complete Block Design (RCBD) replicating thrice. Data were collected on plant height (cm), number of branches plant⁻¹, days to first flowering, height of first capsule (cm), capsule length (cm), capsule width (cm), number of capsules plant⁻¹, number of seeds capsule⁻¹, number of seeds plant⁻¹, 1000-seed weight (g), seed weight plant⁻¹ (g), stover weight plant⁻¹ (g) and harvest index (%). For sowing methods, the maximum plant height (60.90 cm), number of branches plant⁻¹ (2.36), capsule width (0.89 cm), number of capsules plant⁻¹ (13.03), number of seeds capsule⁻¹ (52), number of seeds plant⁻¹ (708.33), seed weight plant⁻¹ (1.99 g), stover weight plant⁻¹ (4.12 g), harvest index (31.10%) and initiation of flowering (35.16 days) was obtained from line sowing method. The lowest plant height (54.85) and seed capsule⁻¹ (49.98) were found in broadcasting whereas the lowest number of branches plant⁻¹ (1.93), capsule length (1.74 cm), capsule width (0.74 cm), number of capsules plant⁻¹ (9.48), number of seeds plant⁻¹ (497.52), seed weight plant⁻¹ (1.39 g), stover weight plant⁻¹ (3.66 g), harvest index (27.05 %) were obtained from dibbling method. Among the rates of nitrogen, 45 kg N ha⁻¹ resulted in the highest plant height (69.99 cm), number of branches plant⁻¹ (2.91), capsule length (1.98 cm), capsule width (0.93 cm), number of capsules plant⁻¹ (16.55) number of seeds capsule⁻¹ (59.15), number of seeds plant⁻¹ (982.42), seed weight plant⁻¹ (2.81 g), stover weight plant⁻¹ (5.50 g) and harvest index (33.60%). Interaction between sowing methods and nitrogen rates significantly influenced all growth and yield attributes except 1000-seed weight (g) and capsule width. The Lowest results were found from combination of sowing methods with control treatments. From the findings of the present study, it can be suggested that line sowing with 45 kg N ha⁻¹ may be followed for the cultivation of sesame (BARI Til-6) in the coastal soil of southwestern Bangladesh.

Keywords: Sowing methods, nitrogen, and interaction.

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Chapter I

Introduction

Sesame (*Sesamum indicum* L.) is an ancient cultivated oilseed crops around the world. It is popular for its oil, edible seeds and also for providing health benefits. In the Indus Valley in South Asia the crop has been cultivated from the Bronze Age and recently has been introduced for domestication in the Indian subcontinent (Langyan et al., 2022).

Sesame seeds contain fat, protein, minerals, vitamins, and fiber. Sesame oil is rich in unsaturated fatty acids, fat-soluble vitamins, amino acids, etc. According to a number of investigations, sesame seeds contain 21.90% protein, 61.70% fat, and are rich in minerals including Fe and Ca (Wei et al., 2022).

Sesame is named as the 'queen of oilseeds' because of its high-quality polyunsaturated stable fatty acids, which prevent oxidative rancidity. The presence of natural antioxidants like sesamin, sesamol, sesamolin, and sesamolol slows down the rate of oxidation. It is widely grown for its drought tolerance behavior and has been extensively used for time immemorial as a globally important seed for edible purpose, cake and confectionary preparation, supplying nutritious proteins covering methionine, tryptophan, valine, and savory roasted essence (Anilakumar et al., 2010). Both seeds and oil of Sesame offer substantial pharmacological and physiological benefits to the whole body, mainly the liver, kidneys, spleen, and stomach organs. In addition to lubricate the intestinal track, its oil feeds the internal organs also (Pathak et al., 2002).

Sesame is the third largest source of edible oil in Bangladesh after *Brassica*, both in terms of area and production. In Bangladesh, the crop can be grown in both the *kharif* and *autumn* seasons, however about 70% of sesame is produced during the *kharif* season. The districts of Faridpur, Khulna, Pabna, Barishal, Comilla, Rajshahi, Jashore, Feni, Rangpur, Sylhet, and Mymensingh are the leading sesame-producing regions in Bangladesh (BBS, 2022). According to BBS (2022-'23), the total area under winter sesame cultivation was 6144.47 acres, per acre yield was 411.21 kg and production was 2526.72 metric ton whereas the total area under summer sesame cultivation was 72329.47 acres, per acre yield was 389.72 kg and production was 28187.96 metric ton.

There is an increasing demand for sesame seed both in local and global markets which provides Bangladesh an immense opportunity to increase its production to meet national requirement for the commodity and to export in foreign countries. The potential of sesame production in the achievement of foreign currency made it a projecting priority in the agricultural sector of the country (Islam et al., 2022).

The climate and soil conditions of Bangladesh are favorable for sesame cultivation and there is very bright scope for large scale farming of sesame. In comparison to other sesame producing countries of the world, the yield and quality seeds of sesame are very poor in Bangladesh which may be attributed due to a number of reasons such as unavailability of quality seeds of high yielding varieties, improper fertilizer management practices, disease and insect infestation and inadequate irrigation facilities (Salam, 2020).

In modern agricultural practices, sowing methods and fertilizer applications are critical for promoting crop development and yield, particularly under rainfed conditions. Because of the ease of planting and a lack of appropriate planting equipment, the broadcast method of sowing is used by the majority of sesame growers. This method is obstructed by uneven seed distribution and seed lying on an open surface, where different birds might pick them up (Ndor and Nasir., 2019).

Nitrogen is a structural component of chlorophyll and protein, therefore a satisfactory supply of nitrogen is advantageous for both carbohydrates and protein metabolism since it helps in cell proliferation and expansion, resulting in higher leaf area and also by ensuring good seed and dry matter yield of sesame. When a larger dose of N was applied, the number of pods/plants, number of seed/pods, seed yield, biomass yield, thousand seed weight, and harvest index were all the highest for sesame. Similarly, the lowest number of pods/plant, number of seeds/pods, seed yield, biological yield, thousand seed weight, and harvest index were reported in control plots having no nitrogen (Ibrahim et al., 2014).

Nitrogen fertilizer has a beneficial stimulus on growth, yield attributes, seed production, and sesame oil quality (Hosseini et al., 2007). According to Reddy et al. (2022), nitrogen increases dry matter yield due to improved carbohydrate and protein metabolism, which promotes cell division and expansion, resulting in more productive pods and dry matter yields. The increased number of branches per plant in sesame might be due to the availability of more nutrients as a result of higher levels of N application allowed the crop to acquire more nutrients and grow more robustly, resulting in superior crop growth and more branches per plant. Increasing nitrogen rates significantly improves plant phenotypic

development, yield per unit area, and yield components of sesame while the lowest values of these characters were reported in plots with no nitrogen (Abdalsalam and Al-Shebani, 2010).

As nitrogen is a component of protein chemistry, it can help increase seed yield and protein content in sesame seeds by creating more protein. Nitrogen (N) has a significant role in seed protein and physiological processes of sesame plants, allowing them to develop rapidly, producing additional seeds and capsules, and also by improving the quality of leaf and oilseed output (Alam, 2002).

Nitrogen has such a significant influence on crop growth and yield that its role becomes obligatory and cannot be replaced in crop and animal production. Unfortunately, its availability, volatilization, leaching losses, toxic nitrate contamination, and other issues have become severe tropical problems, exacerbated by poor soil management techniques and erroneous nitrogen applications. Optimal sesame growth and production characteristics, micronutrient absorption, particularly manganese and zinc increased significantly due to higher rates of nitrogen (Babajide and Oyeleke, 2014).

Adequate nitrogen fertilizer promotes nutrient uptake, particularly P and K, as well as several other micronutrients in sesame. Nitrogen is one of the soil's limiting elements that play an important role in rapid vegetative growth of sesame. Nitrogen is also vital in photosynthesis, the creation of chlorophyll, nucleic acid, and amino acids, which results in tall and densely branched plants. This, in turn, improved flower development and capsule production, increasing the overall output of sesame (Parwar et al., 1993).

An adequate supply of nitrogen is very beneficial for vegetative growth and desirable yield of crops. However, excessive application of nitrogen is not only uneconomical, but it can prolong the growing period and delay crop maturity. Excessive nitrogen application can cause physiological disorder and reduce yield. So, it is very important to apply nitrogen in appropriate rates (Obreza and Vavrina, 1993).

Method of planting is another significant issue in crop production. In Bangladesh, the broadcast method is the most common way to grow sesame since it involves minimum expense and simple agronomic practices. According to several researchers, line sowing produces acceptable yields in other crops (Clarke et al., 1988).

Furthermore, Sevgi et al. (2004) observed that broadcasting interferes with mechanization during subsequent management techniques. Appropriate planting technique not only assures appropriate establishment and optimal plant population in the field, but it also allows the plants to use the land and

other inputs more efficiently and resolutely for growth and output. Sesame yield can be increased significantly by selecting improved planting methods. At line sowing method, the spacing between plants becomes more uniform, so every plant had enough room for light interception. In contrast, with broadcast planting, the distance between two plants can be either close or very distant due to even distribution.

The sowing method had a considerable influence on sesame production, however most farmers used the common dibbling approach. On the other side, line planting methods have a substantial impact on resource utilization, such as water, nitrogen, and phosphorus economy, energy savings, and soil compaction (Troedson et al., 1989).

According to Jan et al. (2015), the sowing method influences the canopy architecture, which affects the crop in two ways: through light interception and distribution, and through linked physiological development and morphological changes. It is well known that broadcast sowing typically resulted in non-uniform plant spacing throughout the field. Uniform plant stands of line sowing provide a significant yield advantage over non-uniform plant spacing in broadcasting.

Line sowing has numerous advantages in comparison to broadcasting. Weed management is one of the key limits of the broadcasting approach in the field, requiring more manpower, a higher seed rate, and a smaller plant population whereas line sowing makes cultural practices easier (Umed et al., 2009).

The nitrogen content of the soil of Bangladesh is quite low and so the judicious application of N fertilizer in adequate quantities, in readily available form, and at the appropriate time to ensure higher seed production is necessary. Planting method is considered an important aspect of advanced production technology which not only ensures better crop establishment but also results in water saving. As a result, it is vital to compare the productivity of sesame grown under various seeding methods. Few researches have been conducted on the effects of various nitrogen rates and sowing method on the growth and yield of BARI Til-6. Therefore, the purpose of the current experiment is to determine the effects of various nitrogen rates and sowing method on the growth and yield of BARI Til-6.

The experiment will be conducted with the following objectives:

1. To evaluate the effects of different sowing methods and various nitrogen rates on growth and yield performance of BARI Til-6, and
2. To find out the proper sowing methods with nitrogen rates for better growth and yield of BARI Til-6 in southwestern coastal Bangladesh.

Chapter II

Review of Literature

Yield performance of sesame is greatly influenced by many factors such as temperature, rainfall, humidity, variety, fertilization, irrigation, seed rate, sowing time, method and spacing. Among them, the effect of nitrogen rates and sowing methods are very important for the production of sesame. This chapter aims at providing a review of relevant literature regarding effect of sowing methods and nitrogen rates of sesame.

2. 1 Effect of Sowing Method on Sesame

The taller plants and greater number of leaves/plant observed dibbling in both sites could be attributed to inter and intra plant competition associated with dibbling method which made the crops to compete more for growth factors compared to other methods (Mohammad et al., 2023).

In modern agronomic crop production practices, sowing methods and fertilizer applications are crucial for increasing crop development and yield, particularly under rainfed conditions. Most sesame growers usually prefer the broadcast method of sowing for sesame production, because of the ease of planting and the lack of suitable planting equipment. This strategy is hindered by uneven seed distributions and seed resting on the open surface, where wild birds can pick them up (Ndor et al., 2019).

Katanga et al. (2017) found that dibbling method produced significantly heavier seeds compared to broadcasting method. However, there were no significant differences between dibbling and drilling as well as between broadcasting and drilling methods. Drilling method produced the highest seed yield followed by broadcasting and then dibbling.

Islam (2017) conducted a study and results revealed that the highest number of capsules plant⁻¹ was obtained from the line sowing method. Broadcasting had the lowest number of capsules per plant. The line sowing method produced the maximum seed weight per plant (6.47 g), which was significantly higher than ridge sowing, and broadcasting produced the lowest seed weight per plant (3.89 g). Line sowing produced the maximum seed yield which distinguished it from broadcasting and ridge planting. The lowest seed yield was discovered by broadcasting. The line sowing approach produced the best yield in the study, which could be due to the larger number of pods per plant, seeds per pod, and 1000-seed weight associated with this practice.

The obtained results reported that broadcasting method produced higher yield, plant height, number of capsules plant, capsule length, number of seeds capsule⁻¹, 1000- seed weight, seed, straw and biological yields, oil seed content compared to drilling method (Kandil, 2015).

Sowing method had significant effect on seed yield and higher seed yield was obtained from line sowing (Adnan et al., 2013)

In comparison to broadcasting, row planting has numerous advantages. Weed management is one of the key limits of the broadcasting approach in the field, requiring more manpower, a higher seed rate, and a smaller plant population (Umed et al., 2009).

According to Islam et al. (2008), the method of sowing showed a non-significant effect on number of branches per plants. However, higher number of branches per plants (3.83 and 5.66) was produced in broadcasting. Higher plant density renders more interplant competition and due to limited space plants fail to produce more capsules per plant. The maximum capsules (29.97) produced by line sowing. It was also evident that the performance of line sowing method is superior to broadcast method in relation of seed yield and other yield parameters. The overall performance of sesame at the line sowing method was found to be the best by producing the topmost grain yield of 1.40 t ha⁻¹.

Data revealed that method of sowing has no significant influence of plant height. The highest plant height (105.7 cm) was recorded in broadcasting method. Line sowing produced higher seed weight (2.62) than broadcasting. Line sowing gave the higher yield (1287 kg ha⁻¹) (Islam et al., 2008).

Imoloame et al. (2007) reported that broadcasting method of sowing produces taller sesame (*Sesamum indicum* L.) plants in the following season, better number of flowers and capsule per plant in both years and the average of two years data.

A field study was conducted on the effect of different planting methods on the growth and yield of two varieties of sesame and it was found that sowing sesame in rows resulted in maximum yield (Ehsanullah et al., 2007).

According to Caliskan et al. (2004), broadcasting causes non-uniform plant populations in the field. It also prevents the mechanization of farming procedures. Planting methods have a substantial effect on sesame crop seed productivity. Row planting resulted in approximately 34% higher seed production than

broadcasting. This could be due to the spatial distribution of plants in a field planted in rows. At row planting method, the spacing between plants became more uniform, so each plant had enough room for light interception. On the other hand, in broadcasting method of planting, the distance between two plants can be either close or very distant due to even distribution in line sowing.

Furthermore, Sevgi et al. (2004) observed that broadcast planting interferes with mechanization during subsequent management techniques. Planting technique not only assures appropriate adjustment and optimal plant population in the field, but it also allows the plants to use the land and other inputs more efficiently and resolutely for growth and output. Sesame yield can be increased significantly by improved planting methods.

Some of the plants had more area to intercept light and absorb moisture and nutrients due to line sowing, while others lacked those necessary growth components. Thus, the phenotypical appearance of the plants varied greatly during broadcast planting. Similarly, non-uniform plant spacing has been shown to reduce seed output significantly in various crop species, including sunflower, corn, and sorghum (Caliskan et al., 2004).

Sowing methods ensure that plants establish and grow properly. Sesame planted on ridges and raised beds have superior moisture availability and retention methods than the flat sowing approach (SESACO, 2014). Raised beds and ridge sowing of sesame produced greater capsules per plant, seed weight per plant and 1000-seed weight as compared with flat and furrow sowing methods (Malik et al., 2003).

These agreed with the findings of Weiss (1983) that dibbling method of sowing produced taller plants and higher dry matter production when compared with drilling method. However, with regards to number of branches per plant, dibbling and drilling gave significantly ($p \leq 0.05$) higher and similar number of branches per plant in three soil types compared to dibbling. This must be attributed to the fact that the crop competes for space, light, and nutrients more intensely in the dibbling approach than in other sowing methods.

Row-sowing was compared with broadcasting at different seed rates where broadcasting, the normal local practice, gave yields slightly higher than those from rows 50 cm apart (Taylor et al., 1986).

Method of planting is another important element in crop cultivation. Broadcast method is the conventional method of growing sesame in Bangladesh as it needs simple agronomic practices with

minimum cost. Yield performance in line sowing is considered to best in other crops as indicated by different researchers (Clarke et al., 1988).

The sowing method had a bigger influence on sesame production, however most farmers used the common dibbling approach. On the other side, planting methods have a substantial impact on resource consumption, such as water, nitrogen, and phosphorus economy, energy savings, and soil compaction (Trodson et al., 1989).



2.2 Effect of Nitrogen Rates on Sesame

According to Reddy et al. (2022), 50 kg nitrogen and 30 kg potassium per ha are sufficient to maintain sesame growth, physiological parameters, and productivity under irrigated north Indian conditions. The increase in dry matter yield could be attributed to nitrogen involvement in carbohydrate and protein metabolism, which promotes cell division and expansion, resulting in more productive pods and dry matter yields. The reason behind the increased number of branches per plant might be due to the acquisition of more nutrients as a result of higher dose of N application that allowed the crop to assimilate more nutrients and grow more lavishly, resulting in better crop growth and higher branches per plant.

Adequate nitrogen fertilizer promotes nutrient uptake, particularly P and K, as well as several micronutrients. Pre-emergence application of mobile nitrogen (urea) is inefficient because to losses. Within two days, a mobile type of nitrogen fertilizer was available for the crop. Split N applications, which apply N fertilizer at distinct periods of crop growth, boost production. Side-dressing is one of the simplest techniques to increase nitrogen use efficiency. N fertilizers should be placed 3-5 cm deeper than seeds and 5-10 cm apart from the plant for side dressing, but not more than 20 cm. Under ideal environmental conditions, nitrogen fertilizer has little effect on phenological features but does affect growth parameters. In prospective areas, applying 46-100 kg N ha⁻¹ maximizes sesame yield, whereas in marginal areas, applying less than 46 kg N ha⁻¹ is more cost-effective (Zenawi et al., 2019).

Ali et al. (2017) described that the plot receiving 70 kg N ha⁻¹ had a greater leaf area per plant of sesame than the control plots, which had a minimum. The application of N at a rate of 70 kg ha⁻¹ produced the best leaf area index, while control plots had a lower leaf area index. Taller plants (187.1 cm) were detected in plots treated with 70 kg N ha⁻¹, while dwarf plants (169 cm) were seen in control plots. Yield

and yield components improved when N and S were added alone or in combination. In this study, the application of N and S at rates of 70 and 20 kg ha⁻¹ improves and makes sesame more profitable.

Significant increases in plant height and dry matter production in sesame crop were seen up to N treatment at 40 kg ha⁻¹. The number of branches per plant in sesame during 50 DAS and harvest was significantly influenced by nitrogen levels when compared to the control, with 40 kg N ha⁻¹ producing the most branches per plant. This level of N increased the number of branches per plant by 2.1 and 8.0% at 50 DAS, and 1.7 and 9.6% at harvest stage, compared to 20 kg N ha⁻¹ and control. This could be due to an increase in nitrogen supply, which aided in rapid cell multiplication and higher chlorophyll content, accelerating the photosynthetic rate and eventually increasing the supply of assimilates to the plant, resulting in increased plant growth in terms of plant height, branches per plant, and dry matter accumulation (Dhaka et al., 2014).

Nitrogen has a significant impact on crop growth and, as a result, crop output for farmers. As a result, its roles become indispensable and cannot be replaced in crop and animal production. Unfortunately, its availability, volatilization, leaching losses, toxic nitrate contamination, and other issues have become severe tropical problems, exacerbated by poor soil management techniques and erroneous nitrogen applications. The application of 80 kg N ha⁻¹ resulted in optimal sesame growth and production characteristics. The application of 80 kg N ha⁻¹ greatly increased micronutrient absorption, particularly manganese and zinc. As urea application quantities increased over 80 kg N ha⁻¹, the percentage of oil content produced decreased significantly. The application of 80 kg N ha⁻¹ is therefore found appropriate and recommended for better sesame performance and soil quality in the tested area (Babajide et al., 2014).

Nitrogen is a structural component of chlorophyll and protein; therefore, an adequate supply of nitrogen is advantageous for both carbohydrates and protein metabolism since it encourages cell proliferation and expansion, resulting in higher leaf area and so confirming good seed and dry matter yield of sesame. When a larger dose of N (90 kg ha⁻¹) was applied, the number of pods plants, number of seed pods, grain yield, biological yield, thousand seed weight, and harvest index were all highest. Similarly, the lowest number of pods plant, number of seeds pods, grain yield, biological yield, thousand seed weight, and harvest index were reported in control plots in sesame (Ibrahim et al., 2014).

Food security, particularly edible oil production, has been a primary priority for agricultural scientists, researchers, and the general public. To address this issue, crops should be produced using newly

released varieties along with current cropping management and inorganic management approaches. Sesame production and yield-related components improved significantly as nitrogen levels increased. Heavier sesame seed was taken from 120 kg N ha⁻¹ (Hasanapour et al., 2012).

Plant height, number of branches/plant, number of leaves/plant, seed yield and stover yield of sesame were increased significantly with increasing N level upto 60 kg N ha⁻¹ (Shilpi et al., 2012).

The data revealed that increasing nitrogen rates by 0, 50, 100, and 150 kg N per hectare significantly improved plant phenotypic growth, yield ha⁻¹, and yield components of sesame. When sesame was fertilized with 150 kg N ha⁻¹, the highest seed output and oil percentage were obtained. The lowest values of these two characters were discovered in plots with zero nitrogen (Abdalsalam et al., 2010).

Higher capsules and seed weight plant⁻¹ of sesame was increased from 0 to 80 kg N ha⁻¹ (Deshmukh et al., 1990). Nitrogen at 120 kg N ha⁻¹ had enhanced seed oil content (53.69%), seed protein content (23.46%), and oil yield (1630 kg ha⁻¹) of sesame (Ramakrishnan et al., 1994). Yield and yield related parameters of sesame were significantly varied up to 150 N kg ha⁻¹. All yield attributes were promoted except oil seed content upto 205 kg N ha⁻¹ (El-Nakhlawy et al., 2009).

Fatima et al. (2007) conducted an experiment on effect of nitrogen on sesame and results revealed that different levels of nitrogen had a significant influence on yield-contributing characters such as flowering habits, plant height, number of branches, plant capsule length, number of seeds capsule, and seed yield ha⁻¹ and 1000 seed weight. The highest number of branches plant⁻¹, number of capsules plant⁻¹, capsule length, number of seeds capsule⁻¹, seed yield ha⁻¹, and 1000 seed weight were obtained with 45 kg N, but the tallest plant was found with 60 kg N ha⁻¹. Increased nitrogen levels beyond 45 kg had no effect on yield attributes, but instead caused decline in the majority of the parameters evaluated.

Hosseini et al. (2007) found that nitrogen fertilizer had a beneficial influence on growth, yield characteristics, seed production, and sesame quality, with the highest sesame seed yield achieved with a 60 kg N ha⁻¹ application.

Malik et al. (2003) found that nitrogen levels had a substantial effect on 1000-seed weight of sesame. The highest 1000-seed weight (3.42 g) was obtained at 80 kg ha⁻¹, followed by 40 kg ha⁻¹, which produced 3.22 g of 1000-seeds. The treatment of 80 kg ha⁻¹ provided the highest seed production (0.794 t ha⁻¹), followed by the 40 kg ha⁻¹ treatment, which yielded 0.716 t ha⁻¹. The control treatment resulted in a minimum seed yield (0.572 t ha⁻¹). The oil contents were dramatically influenced by varying nitrogen

levels. The treatment at 80 kg ha⁻¹ provided the maximum oil output (45.88%), followed by 40 kg ha⁻¹ (44.33%).

Pathak et al. (2002) conducted a field experiment to determine the influence of nitrogen levels (0, 15, 30, and 45 kg ha⁻¹) on sesame growth and yield. They reported that nitrogen administration at 45 kg ha⁻¹ resulted in the maximum plant height, number of branches, number of capsules plant⁻¹ and 1000 grain weight. Nitrogen at 45 kg ha⁻¹ also produced the highest seed yield.

The tallest plants, highest number of capsules plant⁻¹ and highest seed yield of sesame were obtained with an application of nitrogen at 45 kg ha⁻¹ (Saharia and Bayan, 1996).

The leaf area index (LAI) response to nitrogen was seen to reach up to 90 kg N ha⁻¹, whereas the number of capsuled plants and 1,000-seed weight increased only to 30 kg N ha⁻¹. The maximum oil (%) was recorded after two irrigations and at 30 kg N ha⁻¹. Higher N levels decreased oil (%) in sesame. Plant nitrogen uptake improved considerably up to three irrigations and 90 kg N ha⁻¹ (Kumar et al., 1996).

Mankar et al. (1995) who reported that 1000-seed weight of sesame increased with increasing rate of N.

Sumathi and Jaganadham (1994) produced the highest sesame yield with 60 kg N per hectare. Seed oil contents were increased by N application except at the highest rate (90 kg N ha⁻¹).

Kumar and Prasad (1993) reported from an experiment that sesame seed output increased with nitrogen fertilizer rate from 0.13 t ha⁻¹ (without nitrogen) to 0.92 t ha⁻¹ with 90 kg N ha⁻¹, although seed oil concentration was maximum (47%) with 30 kg N ha⁻¹, and then decreased.

According to Osman (1993), applying 40 kg N ha⁻¹ greatly increased grain yield and yield characteristics in sesame crops.

Parwar et al. (1993) reported that seed yield in sesame was maximum with 120 kg N ha⁻¹.

Shrivastava and Tripathi (1992) conducted a field experiment in India and demonstrated that nitrogen rates of 30, 60, and 90 kg/ha improved seed production from 0.87 t ha⁻¹ with 30 kg N ha⁻¹ to 1.27 t ha⁻¹ with 90 kg N ha⁻¹.

Chapter III

Materials and Methods



3.1. Experimental Site

The experiment was carried out at the Regional Inspection Center (RIC), Bangladesh Meteorological Department, Gollamari, Khulna. The experimental site is situated in the agro-ecological zone of Gangetic Tidal Floodplain (AEZ-13) (Appendix A).

3.2. Climate

The experimental location enjoys a subtropical climate, which is characterized by high temperature with high humidity, and heavy rainfall with irregular gusty winds during the *kharif-1* season (March-July), as well as reasonably low temperatures in the *rabi* season.

3.3 Soil

The experimental site is a part to the Ganges Tidal Floodplain. This region is situated in the country's southwestern part and covers a large portion of tidal floodplain. The vast majority of this terrain topographies smooth relief with high salt levels. The majority of the top soils are acidic in nature, while sub-soils range from neutral to marginally alkaline. The fertility level is high, with organic matter content ranging from medium to high. The experimental area was level having a drainage and irrigation opportunity. From the experimental field Soil samples were collected from depths ranging from 0 to 15 cm. The soil analysis was done at the Soil Resource Development Institute (SRDI), Khulna. Results of the soil analysis are placed in the Appendix B.

3.4 Planting Material

BARI Til-6 was used as the planting material.

3.5 Experimental Design

The experiment will be conducted in a Randomized Complete Block Design (RCBD) with double factors.

Factor A (sowing method): 03

S₁ = Broadcasting

S₂ = Line sowing

S₃ = Dibbling

Factor B (N rate): 04

N₀ = 0 kg/ha

N₁ = 15 kg/ha

N₂ = 30 kg/ha

N₃ = 45 kg/ha

No. of Replication: 3

No. of Treatment Combinations: 12

No. of Plots: 36

3.6. Land Preparation

The land was initially ploughed by a tractor. The soil was then brought to a suitable tilth by ploughing and harrowing several times using a country plough and ladder. The weeds and stubbles were then removed. The total experimental land was divided into unit plots based on the experimental design. Before planting, the basal dose of fertilizers was applied properly.

3.7. Fertilizer Application

First half of the Urea and full dose of TSP, MoP, Gypsum, and Boric acid was applied during final land preparation. Rest of the Urea was applied in split at 30 days after sowing (DAS). Urea, TSP, MoP, Gypsum, and Boric acid were applied at the rate of 120 kg/ha, 120 kg/ha, 40 kg/ha, 100 kg/ha and 10 kg/ha respectively.

3.8. Seed Sowing

Seeds of sesame were sown on 20 February, 2024 following the layout of the investigation. For line sowing, line to line distance was kept 30 cm. Broadcasting was done by blending the sesame seeds with sands. Dibbling was completed by placing sesame seeds in small holes and then covered with loose soil. The seed rate followed was 8 kg/ha.

3.9. Intercultural Operations

The following intercultural operations were performed for favoring normal growth of the crop.

3.9.1 Weeding

Weeding was done two times during crop growth period using a Nirani. First weeding was done at 20 DAS and the second weeding at 35 DAS.

3.9.2 Thinning

Thinning was performed to maintain a uniform plant population in each experimental plot at 25 DAS of sesame seeds.

3.9.3 Irrigation and Drainage

One pre-sowing irrigation was given to maintain the uniform seed germination of sesame. Excess water was drained out during the irrigation.

3.9.4 Plant Protection Measures

During the growth period some plants were attacked by cutworm. It was controlled by spraying Dursban 20 EC at 2 ml/l at the time of infestation period.

3.10 General Observation of the Experimental Field

The research field appeared to be in good condition, with typical green flora. Field was visited on a regular basis to detect visible differences among the treatments and any form of infestation by weeds, insects and diseases in order to significantly minimize pest losses.

3.11 Harvesting and Threshing

The crop was harvested on May 15, 2024. The crop was collected plot-wise when approximately 80% of the capsules had matured. Five representative plants were collected from the central area of each plot, then tied firmly into bundles and sent to the threshing floor for seed separation. The bundles were then dried in the open sun for three days. The seeds were separated from the pods by beating with bamboo sticks, then cleaned, dried, and weighed. The weight of dry stover was also measured.

3.12 Collection of Experimental Data

Data were collected regarding various sesame plant characteristics. Five plants were selected randomly from each plot, ignoring the border plots outside the center 1 m² area. The sample plants were carefully pulled out from the soil using a khurpi so that no seeds were dropped into the soil, then cleaned, dried, and data on the following crop attributes were collected from those samples.

- i. Plant height (cm)
- ii. Number of branches/plant
- iii. Days to first flowering
- iv. Height of first capsule (cm)
- v. Capsule length (cm)
- vi. Capsule width (cm)
- vii. Number of capsules/plant
- viii. Number of seeds/capsule

- ix. Number of seeds/plant
- x. 1000 seed weight (g)
- xi. Seed weight/plant (g)
- xii. Stover weight/plant (g)
- xiii. Harvest index (%)

3.12.1. Plant Height

The height of five representative plants was measured from the base of the plant to the tip of the plant at 35, 45, 55, 65 and 75 DAS and the mean height was expressed in centimeter.

3. 12.2 Branches per Plant

The number of branches/plant was counted from the preselected five plants and mean values were taken.

3. 12.3 Days to Flowering (days)

The number of days required for flower initiation per plot was counted from all the plots and values were taken. The mean number was expressed.

3. 12.4. Capsules per Plant

The number of capsules per plant was counted from all the branches of the preselected five plants and the mean was expressed as per plant basis.

3. 12.5 Height of First Capsule (cm)

The first capsule height was taken from the randomly previously selected 5 plants. This was computed using a measuring tape and finally first capsule height was determined.

3. 12.6 Capsule Length (cm)

The length of capsule was measured by randomly preselected 10 capsules. The length of each capsule was calculated using a measuring tape and finally average capsule length was determined.

3. 12.7 Capsule Width (cm)

The capsule width was determined from randomly preselected 10 capsules. The width of each capsule was computed using a measuring tape and finally average capsule length was determined.

3. 12.8 Seeds per Capsule

From each sample plant of five sampled plants, 10 capsules were randomly selected and all the seeds of them were counted, the number of seeds per capsule was determined by taking the average of the data.

3. 12.9 Seeds per Plant

From each sample plant of five sampled plants, all the seeds from capsules of them were counted, the number of seeds per plant was determined by averaging the data.

3. 12. 10. 1000 Seed Weight (g)

One thousand cleaned and dried sesame seeds were counted and then measured by means of an electronic balance and the weight was expressed in gram.

3. 12. 11 Seed Yield (g)

Weight of seeds of the sample was taken and then converted to the yield in seed yield (g)/plant.

3. 12. 12. Stover Yield (g)

The weight of stover yield was taken after oven drying and was converted to stover yield (g)/plant.

3. 12.13. Harvest Index (%)

It is the ratio of economic yield to biological yield and was calculated with the following formula (Gardner et al., 1985).

Harvest index (%) = (grain yield/biological yield) x 100

Biological yield = Grain yield + stover yield (dry weight basis)

3.13 Statistical Analysis of the Data

All the data collected were compiled and analyzed following analysis of variance (two-way ANOVA) using computer package 'Statistix-10'. The mean comparison among the treatment were performed by Tukey's HSD test at 95% confidence level. Simple linear regression analysis was done by MS-Excel to develop functional relationship between seed yield and biological yield, seed yield and harvest index as well as seed yield and stover yield of BARI Til-6.



Chapter IV

Results and Discussion

4.1. Plant Height (cm)

4.1.1. Effect of Sowing Method

The height of sesame plants increased over time gradually and reached the maximum at 75 DAS in all the sowing methods. The results showed that plant height was significantly influenced by sowing methods as shown in Table 4.1. The highest mean plant height (60.9 cm) was obtained from the line sowing method followed by dibbling (55 cm) and the shortest mean plant height (54.85 cm) was recorded from broadcasting. Plant height was statistically superior at line sowing whereas broadcasting and dibbling produced statistically similar results. According to Caliskan et al. (2004), with line sowing, the spacing between plants became more equal, allowing each plant to have enough area for light interception, whereas with broadcast planting, the distance between two plants might be either close or quite distant due to even distribution. Line sowing provides increased nitrogen availability and uptake, which gradually improves plant vegetative development and results in higher plant height (Alam, 2002). Contrary to our findings, Imoloame et al. (2007) found that the broadcasting method of seeding resulted in taller sesame plants. Mohammad et al. (2023) discovered that dibbling produced higher plants. Islam et al. (2008) found no significant association between sowing method and plant height. Delgado and Yermanos (1975) and Gupta (1982) found that higher plant density resulted in lower plant height and *vice versa*. Plants that were more widely separated grew to be taller. The largest plant height produced may be owing to the fact that plant density is optimal for interplant competition to use space, light, and nutrients, which may contribute to the highest plant height.

4.1.2. Effect of Nitrogen

Results of the present study showed that plant height was significantly influenced by nitrogen levels as shown in Table 4.2. The highest mean plant height (67.99 cm) was obtained from the highest dose of N application (45 kg N ha⁻¹) followed by 30 kg N ha⁻¹ (62.92 cm) and the shortest plant (42.67 cm) was recorded from 0 kg N ha⁻¹. Plant height was statistically different at all 4 rates of nitrogen application. Patra et al. (2002) found similar results. Pathak et al. (2002) also conducted from a field experiment to assess the effect of nitrogen levels (0, 15, 30, and 45 kg ha⁻¹) on sesame growth and yield, found that nitrogen application at 45 kg/ha resulted in the highest plant height. Fatima et al. (2007) conducted an experiment on the effect of nitrogen on sesame, and the results showed that different nitrogen levels had significant effects on plant height, with the tallest plants found at 60 kg N ha⁻¹.

Dhaka et al. (2014) reported significant increases in plant height and dry matter production up to N treatment at 40 kg ha⁻¹. An increase in nitrogen supply aided in rapid cell multiplication and higher chlorophyll content, accelerating the photosynthetic rate and eventually increasing the supply of assimilates to the plant, resulting in increased plant growth in terms of plant height (Dhaka et al., 2014).

4.1.3. Interaction Effect of Nitrogen and Sowing Method

The interactive effect of sowing method and nitrogen rates showed significant influence in plant height as shown in Table 4.3. Plant height was observed highest in combination with line sowing and 45 kg N ha⁻¹ (72.18 cm) followed by dibbling and 45 kg N ha⁻¹ (66.56 cm). Broadcasting and 45 kg N ha⁻¹ (65.22 cm) occupied the third place. Combination of broadcasting with no nitrogen resulted in the shortest plant height (40.34 cm). Combination of dibbling with no nitrogen resulted in the second lowest plant height (43.44 cm). At broadcasting, there was no statistical difference of plant height at 30 and 45 kg N ha⁻¹ but plant height was significantly higher at 15, 30 and 45 kg N ha⁻¹ compared to controlled plots. In line sowing and dibbling, plant height was statistically different at all 4 nitrogen rates and was the highest at 45 kg N ha⁻¹.

4.2 Number of Branch per Plant

4.2.1 Effect of Sowing Method

The results of the present finding showed that number of branches per plant at harvest was significantly inclined by sowing methods as shown in Table 4.1. The highest number of branch/plant was obtained from the line sowing method (2.36) followed by broadcasting (1.97) and the lowest branch/plant (1.93) was recorded from dibbling. Islam (2017) found that the highest number of branches/plant was obtained from the line sowing method whereas the lowest number of branches/plant was found from the broadcasting sowing method. Khanam et al. (2022) also found that line sowing produced taller plants and higher number of branches. Hamid et al. (2002) opined that the highest number of branches/plant in line sowing method. Interplant competition is less in wider spaced crop and it offers the plants to the pants to express its full potential to produce more branches. Islam et al. (2008), however, found that whereas broadcasting increased the number of branches per plant, planting technique had little effect on the number of branches per plant.

4.2.2 Effect of Nitrogen

The effect of nitrogen on branch production in sesame is given in Table 4.2. The finding of our study showed that number of branches per plant was significantly influenced by nitrogen rates. The highest mean number of branch/plant (2.91) was obtained from 45 kg N ha⁻¹ followed by 30 kg N ha⁻¹ (2.31) and the lowest (1.37) was observed from controlled plots. Thakur et al. (1993) also found similar results. Suhrahmaniyan et al. (1999) also reported that 45 kg N ha⁻¹ increased number of primary branches per plant. Nitrogen fertilizer has been shown to boost crop growth and production. This result is consistent with the findings of Malik et al., (2003), who revealed that nitrogen fertilizer has a significant influence on oilseed crops. The application of 45 to 80 kg N/ha increased the number of branches per plant in sesame. This conclusion is also consistent with the findings of Umar et al. (2012), who found that applying 60 kg to 80 kg N ha⁻¹ produced a greater number of branches. Nitrogen application at higher rates increased the number of branch per plants because it improves photosynthetic rate and eventually increases the availability of assimilates to the plant, resulting in higher plant growth and branches per plant (Dhaka et al., 2014).

4.2.3 Interaction Effect of Nitrogen and Sowing Method

The interaction effect of sowing method and nitrogen rates showed significant influence in number of branches per plant (Table 4.3). Number of branches per plant was noted to be the highest in combination with line sowing and 45 kg N ha⁻¹ (3.13) followed by broadcasting and 45 kg N ha⁻¹ (3). Dibbling and 45 kg N ha⁻¹ (2.6) occupied the third place. Combination of broadcasting with no nitrogen resulted in the lowest number of branches (1.13). The highest number of branches were produced by Nitrogen at 45 kg ha⁻¹ and the lowest were produced from no nitrogen at all of the 3 sowing methods. S₁N₃ and S₂N₃ statistically similar as there was no significant difference between them in terms of number of branches per plant. S₁N₂, S₂N₂ and S₃N₃ also produced statistically similar results.

4.3 First Flowering (days)

4.3.1 Effect of Sowing Method

The first flowering period in sesame was significantly influenced by sowing methods (Table 4.1). The earliest first flowering was obtained from the line sowing method (35.16 days). There was no statistical difference between broadcasting and dibbling in case of first flowering. Adnan et al. (2013) also found similar results. Islam et al. (2017) also observed similar effect that the lowest days to 1st flowering (41.45) were found from the line sowing method which was statistically different from broadcasting. At line sowing method, each plant had enough room for light interception due to uniform spacing compared to broadcast planting which can positively influence flowering.

4.3.2 Effect of Nitrogen

The number of days required to first flowering in BARI Til-6 was significantly influenced by nitrogen rates as shown in Table 4.2. The earliest flowering (35 days) occurred at 30 and 45 kg N ha⁻¹ and these two treatments were statistically similar. Flowering initiation took the longest time for controlled plots (37.33 days). However, Haruna (2011) found that unfertilized plot was flowering 14% earlier than the 100 kg N/ha treated plot. Similarly, higher N application has delayed flowering compared to the unfertilized ones in the drought-prone area. However, Ogundare et al. (2015) revealed that in regions with higher rainfall, urea application rates had no effect on the flowering date, and that in areas

susceptible to drought, zero fertilization might cause the plant to flower earlier than one that has been fertilized.

4.3.3 Interaction Effect of Nitrogen and Sowing Method

The interactive effect of sowing method and Nitrogen rates showed significant influence in days to first flowering as shown in Table 4.3. S_1N_2 , S_1N_3 , S_2N_0 , S_2N_1 , S_2N_2 , S_2N_3 , S_3N_2 and S_3N_3 were statistically similar (35 days). S_3N_0 and S_1N_1 were also statistically similar. S_1N_0 took the longest for first flowering.

4.4 Height of First Capsule (cm)

4.4.1 Effect of Sowing Method

The height of first capsule (cm) of sesame cv. BARI Til-6 was significantly influenced by sowing methods as described in Table 4.1. The highest mean height of first capsule (27.36 cm) was obtained from line sowing method and it was statistically superior to broadcasting and dibbling. Broadcasting and dibbling produced statistically similar results.

4.4.2 Effect of Nitrogen

The various nitrogen doses exhibited significant influence on the height of first capsule of sesame (Table 4.2). The nitrogen rate of 30 kg N ha⁻¹ produced the highest mean height of first capsule (27.82 cm) followed by 45 kg ha⁻¹ (27.80 cm) and there was no statistical difference between these two treatments. The third place was occupied by 15 kg N ha⁻¹ (25.57 cm) and was followed by the control treatment (25.12 cm). There was no statistically significant distinction between the two treatments.

4.4.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that the height of first capsule was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.3. S_1N_3 produced the highest first capsule height (29.05 cm). There was no statistical difference among S_1N_2 , S_1N_1 , S_2N_3 , S_3N_2 , S_3N_3 and S_3N_0 were statistically similar. S_2N_0 , S_3N_1 , S_1N_1 and S_1N_0 also produced the similar results. The lowest value was produced by broadcasting and control.

4.5 Length of Capsule (cm)

4.5.1 Effect of Sowing Method

The capsule length of sesame *cv.* BARI Til-6 was not significantly influenced by sowing methods as described in Table 4.1. The highest mean capsule length (1.8 cm) was obtained from broadcasting method. Capsule length was statistically similar at line sowing and broadcasting. Line sowing and dibbling also produced statistically similar results.



4.5.2 Effect of Nitrogen

The various nitrogen doses exhibited significant influence on capsule length of sesame (Table 4.2). The highest mean capsule length was obtained from the nitrogen rate of 45 kg ha⁻¹ (1.98 cm) followed by 30 kg N ha⁻¹ (1.86 cm). The third place was occupied by 15 kg N ha⁻¹ (1.73 cm) and was followed by the control treatment (1.54 cm). Fatima (2007) opined that nitrogen has a significant effect on the length of capsule. The longest capsule was formed by 45 kg and 60 kg N ha⁻¹, which were significantly different from the capsule lengths when treated with 30 kg N ha⁻¹. As expected, the shortest capsules were noted from the control. It can be linked to the fact that nitrogen supply promotes rapid cell multiplication and higher chlorophyll content, so increasing the photosynthetic rate and, ultimately, the plant's supply of assimilates, resulting in longer capsule length.

4.5.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that capsule length was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. There was no statistical difference among S₁N₃, S₁N₃, S₂N₃, S₂N₂, S₃N₃ and S₂N₃ but S₁N₃ and S₂N₃ produced the highest capsule length (2.02 cm). The lowest capsule length was produced by dibbling and control.

4.6 Width of Capsule (cm)

4.6.1 Effect of Sowing Method

In the present study it was found that capsule width was significantly influenced by sowing methods as shown in Table 4.1. Capsule width was statistically similar at line sowing (0.89 cm) and broadcasting (0.88 cm). Line sowing and broadcasting were statistically superior to dibbling (0.74 cm).

4.6.2 Effect of Nitrogen

The present finding showed that capsule width was significantly influenced by nitrogen rates as shown in Table 4.2. The highest mean capsule width was obtained from the Nitrogen rate of 45 kg ha⁻¹ (0.93 cm) followed by 30 kg N ha⁻¹ (0.91 cm) and these were statistically similar. The third place was occupied by 15 kg N ha⁻¹ (0.80 cm) and the lowest mean capsule/plant (0.70 cm) was recorded from control. Results from the previous two were statistically different.

4.6.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that capsule width was not significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. There was no statistical difference among S₁N₁, S₁N₂, S₁N₃, S₂N₁, S₂N₂, S₂N₃, S₂N₃ and S₃N₃ but S₁N₃ and S₂N₃ produced the highest capsule width (0.98 cm). Lowest capsule length was produced by dibbling and control.

4.7 Number of Capsule per Plant

4.7.1 Effect of Sowing Method

The finding of the present investigation showed that number of capsules per plant was significantly influenced by sowing methods (Table 4.1). The highest number of capsules/plant was obtained from the line sowing method (13.03) followed by broadcasting (10.76) and the lowest capsules plant⁻¹ (9.48) was recorded from dibbling. The findings of the present study were similar to those of Hamid et al. (2002). According to Wakweya and Meleta (2016), the line sowing approach produced considerably more capsules per plant than the broadcast method. Islam (2017) also found that number of capsules plant⁻¹ was significantly influenced by sowing methods. Results exposed that the highest number of capsules plant⁻¹ was obtained from the line sowing method, and broadcasting showed lowest number of capsules plant. Similar result was also obtained from the findings of Adnan et al. (2013) and Caliskan et al. (2004). However, Islam (2008) found that method of sowing produced no significant influence on the number of capsules plant⁻¹. Imoloame et al. (2007) also found that the maximum capsules were produced by line sowing. Khanam et al. (2022) also found that sowing methods had significant effect on number of capsules plant⁻¹. The line sowing method produced the maximum number of capsules plant⁻¹ compared to broadcast sowing.

4.7.2 Effect of Nitrogen

The number of capsules per plant of sesame was significantly influenced by nitrogen rates as shown in Table 4.2. The highest number of capsule/plant was obtained from the nitrogen rate of 45 kg ha⁻¹ (16.55) followed by 30 kg N ha⁻¹ (12.73). The third place was occupied by 15 kg N ha⁻¹ (8.57) and the lowest capsule/plant (6.5) was recorded from control. Results from the four different N rates were statistically different. Waziri et al. (2022) obtained similar results and suggested that this could be due to the fact that nitrogen is one of the soil's limiting elements and plays a significant role in rapid vegetative growth. Nitrogen is also vital in photosynthesis, the creation of chlorophyll, nucleic acid, and amino acids, which results in tall and densely branched plants. This, in turn, improved flower development and capsule production, increasing the overall output. This conclusion is consistent with the findings of Parwar et al. (1993), who found that sesame yield characteristics increased with higher nitrogen fertilizer treatment. Capsule and seed weight per plant rose from 0 to 80 kg N ha⁻¹ (Deshmukh et al., 1990). This result is consistent with the findings of Malik et al., (2003), who revealed that nitrogen fertilizer has a significant influence on oilseed crops and the application nitrogen at of 45 kg to 80 kg ha⁻¹ increased the number of

capsules per plant in sesame. This conclusion is also consistent with the findings of Umar et al. (2012), who found that applying 60 kg to 80 kg N ha⁻¹ increased the quantity capsules per sesame plant.

4.7.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that number of capsule per plant was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. The highest number of capsule per plant was found in S₂N₃. There was no statistical difference among S₁N₀, S₂N₀ and S₃N₀.

4.8 Number of Seeds per Capsule

4.8.1 Effect of Sowing Method

It was found from the present study that number of seeds per capsule was significantly influenced by sowing methods as given in Table 4.1. The highest number of capsule/plant was obtained from the line sowing method (52) followed by dibbling (50.92) and the lowest capsule/plant (49.98) was recorded from broadcasting. Ehsanullah et al. (2007) and Caliskan et al. (2004) found that number of seeds /capsule was significantly influenced by sowing methods of sesame and the highest number of seeds/capsule was obtained from the line sowing method which was significantly different from broadcasting. Broadcasting showed significantly lowest number of seeds/capsule. The present study's observations were in line with those of Islam et al. (2008), who found that line sowing techniques were superior for crop growth development and how it affected sesame production qualities. The number of seeds capsule-1 was significantly impacted by the sowing techniques (Svathi et al., 2005). Waziri et al. (2022) discovered, however, that the dibbling process produced noticeably more capsules than the other methods. According to Snider et al. (2012), spaced plants can receive adequate sunlight, water, and nutrients from the soil, influencing plant health and productivity. According to Jan et al. (2015), the sowing method influences the canopy structure, which affects the crop in two ways: through light interception and distribution, and through linked physiological development and morphological changes. It is well known that broadcast sowing typically resulted in non-uniform plant spacing throughout the field. Uniform plant stands provide a significant yield advantage over non-uniform plant spacing. Non-uniform plant spacing has been shown to significantly reduce seed yield in various crop species, including sunflower (Barros et al., 2003), corn (Bavec et al., 2002), and sorghum (Abunyewa et al., 2010).

4.8.2 Effect of Nitrogen

The mean number of capsules per plant was significantly influenced by nitrogen rates (Table 4.2). The highest mean number of seed/capsule was obtained from the nitrogen rate of 45 kg ha⁻¹ (59.15) followed by 30 kg N ha⁻¹ (54.13). The third place was occupied by 15 kg N ha⁻¹ (49.08) and the lowest mean number of seed/capsule (41.48) was recorded from control. Results from the four different N rates were statistically different. Nitrogen applied at 45 kg ha⁻¹ produced the tallest plants, the greatest number of capsules plant⁻¹, and the largest seed output (Saharia and Bayan, 1996). Waziri et al. (2022) stated that the effect of nitrogen fertilizer significantly affected number of seeds/capsule as well as yield/hectare. The result revealed that the application of 60 kg N/ha significantly gave higher number of seeds/capsule and yield/hectare respectively. The increase in number of seeds per capsule and yield per hectare of sesame could be as a result of response of the sesame plant to application of nitrogen. Nitrogen fertilizer has been shown to boost crop growth and production.

4.8.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that number of seed per capsule per plant was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. S₂N₃ produced the highest number of seed per capsule (61.66). There was no statistical difference among S₁N₃ and S₂N₃. S₁N₀, S₂N₀ and S₃N₀ were statistically similar.

4. 9 Number of Seeds per Plant

4. 9.1 Effect of Sowing Method

The present research showed that number of seeds per plant was significantly influenced by sowing methods (Table 4.1). The highest mean number of seeds/plant was obtained from the line sowing method (708.33) followed by broadcasting (565.12) and the lowest mean capsule/plant (497.52) was recorded from dibbling. Results from broadcasting, line sowing and dibbling were statistically different. However, Katanga et al. (2017) found that sowing method had no significant effect on seed yield per plant but broadcasting was superior to dibbling. Kandil (2015) found that the sowing sesame plants by broadcasting method resulted the highest mean values of seeds per plant. Khanam et al. (2022) found that higher seed yield was produced in line sowing method while the plants of sesame grown under broadcast sowing recorded the lower seed yield. Similar results were also reported by Svathi et al. (2005) and Islam et al. (2008).

4. 9. 2 Effect of Nitrogen

The different nitrogen rates created significant influence on the number of seeds per plant as shown in Table 4.2. The highest mean number of seed/plant was obtained from the nitrogen rate of 45 kg ha⁻¹ (982.42) followed by 30 kg N ha⁻¹ (687.20). The third place was occupied by 15 kg N ha⁻¹ (421.44) and the lowest mean number of seed/plant (270.22) was recorded from control. Malik et al., (2003) reported that nitrogen fertilization has been found to have profound effect on oilseed crops. Nitrogen fertilizer has been found to improve growth and yield of crop plants. The application of 45 kg to 80 kg N ha⁻¹ increased the number of seeds per plant in sesame. This finding is also consistent with the research conducted by Umar et al. (2012), who found that applying 60 kg to 80 kg N ha⁻¹ increased the amount of seeds produced by sesame plants per plant.

4. 9. 3 Interaction Effect of Nitrogen and Sowing Method

The present study showed that number of seed per plant was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. S_2N_3 produced the highest number of seed per plant (1188.8) was statistically superior to all other treatments. S_1N_0 produced the lowest seed/plant and other treatments were statistically different from each other.



4. 10 1000-Seed Weight (g)

4. 10.1 Effect of Sowing Method

The 1000 seed weight of BARI Til-6 was not significantly influenced by sowing methods (Table 4.1). There was no statistical difference among the sowing methods. However, Islam (2017) found that sowing methods showed significant influence regarding 1000 seed weight and the highest 1000 seed weight was obtained from the line sowing method which was significantly different from broadcasting gave significantly lowest 1000 seed weight. Islam (2008) also found that line sowing produced higher 1000 seed weight than broadcasting.

4. 10 .2 Effect of Nitrogen

The present investigation showed that 1000 seed weight per plant was significantly influenced by nitrogen rates (Table 4.2). The highest mean number of seed weight/plant was obtained from the nitrogen rate of 45 kg N ha⁻¹ (2.87 g). There was no statistical difference among the rest of the nitrogen treatments. Nitrogen is a structural component of chlorophyll and protein, therefore having an appropriate supply of nitrogen is beneficial for both carbohydrate and protein metabolism because it promotes cell proliferation and expansion, resulting in better seed yield. When a higher dose of nitrogen (90 kg ha⁻¹) was applied, 1000 seed weight was maximum. Similarly, control plots showed the lowest number (Ibrahim et al., 2014). Fatima et al. (2007) found that the highest 1000 seed weight were obtained with 45 kg N and increased nitrogen levels beyond 45 kg had no effect on yield attributes, but instead caused decline in the majority of the parameters evaluated.

4. 10.3 Interaction Effect of Nitrogen and Sowing Method

The present study showed that 1000-seed weight (g) was not significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. There was no statistical difference among the treatments.

4. 11 Seed Weight per Plant (g)

4. 11.1 Effect of Sowing Method

The seed weight per plant of BARI Til-6 was significantly influenced by sowing methods (Table 4.1). The highest number of seeds/plant was obtained from the line sowing method (1.99 g) followed by broadcasting (1.59 g) and the lowest capsule/plant (1.39 g) was recorded from dibbling. Islam (2017) also found that sowing methods showed significant influence regarding seed weight/plant. The highest seed weight/plant was obtained from the line sowing method which was significantly different from broadcasting gave significantly lowest seed weight/plant. Islam (2008) also found that line sowing produced higher seed weight than broadcasting.

4. 11.2 Effect of Nitrogen

The present investigation showed that seed weight per plant was significantly influenced by nitrogen rates (Table 4.2). The highest mean number of seed weight/plant was obtained from the nitrogen rate of 45 kg N ha⁻¹ (2.81 g) followed by 30 kg N ha⁻¹ (1.90 g). The third place was occupied by 15 kg N ha⁻¹ (1.17 g) and the lowest mean number of seed weight/plant (0.74 g) was recorded from control. Nitrogen is a structural component of chlorophyll and protein, therefore having an appropriate supply of nitrogen is beneficial for both carbohydrate and protein metabolism because it promotes cell proliferation and expansion, resulting in better seed yield. When a higher dose of nitrogen (90 kg ha⁻¹) was applied, grain production and biological yield were maximum. Similarly, control plots showed the lowest number (Ibrahim et al., 2014). Seed and stover yields improved dramatically when N levels increased up to 60 kg N ha⁻¹ (Shilpi et al. 2012). Pathak et al. (2002) conducted a field experiment to investigate the effects of nitrogen levels (0, 15, 30, and 45 kg ha⁻¹) on sesame growth and yield. They found that nitrogen administration at 45 kg ha⁻¹ produced the highest seed yield.

4. 11.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that seed weight per plant was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. S_2N_3 produced the highest seed weight per plant (3.4 g) was statistically superior to all other treatments. S_1N_0 produced the lowest seed weight/plant and S_1N_0 , S_1N_1 , S_2N_0 , S_2N_1 , S_3N_0 and S_3N_1 were statistically similar.

4. 12 Stover Weight per Plant (g)

4. 12. 1 Effect of Sowing Method

The results of our research indicated that stover weight per plant was significantly influenced by sowing methods as shown in Table 4.1. The highest stover weight per plant was obtained from the line sowing method (4.12 g). Results from broadcasting and dibbling were statistically same. Khanam et al. (2022) found that higher stover yield was recorded from the line sowing while broadcast sowing showed lower stover yield. Islam (2008) found that the method of sowing and interaction treatments showed insignificant influence. However, line sowing produced higher stover yield. Wakweya and Meleta (2016) found that sowing techniques had a substantial impact on biomass yield, which supported the current findings regarding stover yield. Islam (2017) observed significant variation due to sowing method for stover yield of sesame. The highest stover yield was obtained from the line sowing method which was significantly different from broadcasting.

4. 12.2 Effect of Nitrogen

The influence of nitrogen on stover weight per plant of sesame was significant as shown in Table 4.2. The highest mean amount of stover weight/plant was obtained from the nitrogen rate of 45 kg ha^{-1} (5.50 g) followed by 30 kg N ha^{-1} (4.35 g). The third place was occupied by 15 kg N ha^{-1} (3.17 g) and the lowest mean amount of stover weight/plant (2.25 g) was recorded from control. As the nitrogen level increased, so did the stover yield, with the highest level of nitrogen (120 kg ha^{-1}) producing the highest production and the lowest yield in the control plot. Nitrogen fertilizer delays physiological maturity by extending the crop's vegetative period, allowing the plant to reach its maximum number of branches per plant and height, increasing stover output. These findings are consistent with the findings of Shehu et al. (2010), who showed a considerable increase in stover yield with increasing nitrogen levels. Shilpi et al.

(2012) discovered that stover yield rose dramatically when N level increased up to 60 kg N ha⁻¹. According to Ibrahim et al. (2014), nitrogen is a structural component of chlorophyll and protein, so an adequate supply of nitrogen is beneficial for both carbohydrate and protein metabolism because it promotes cell proliferation and expansion, resulting in increased leaf area and thus good dry matter output. The highest biological yield was achieved when a higher N dose (90 kg ha⁻¹) was applied. Similarly, control plots produced the lowest biological yield. Tiwari et al. (2000) and Om-Prakash et al. (2001) reported that stover yield was directly proportional to nitrogen fertilization, possibly due to luxuriant vegetative growth of plants with increased nitrogen application, which tended to enhance dry matter production and, ultimately, stover yield.

4. 12.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that seed weight per plant was significantly influenced by the interaction of sowing methods and nitrogen rates (Table 4.4). S₂N₃ produced the highest stover weight per plant (3.4 g) was statistically superior to all other treatments. S₁N₃ produced the lowest stover weight/plant and S₁N₂, S₂N₁ and S₂N₂ were statistically similar.



4. 13 Harvest Index (%)

4. 13.1 Effect of Sowing Method

The outputs of the present experiment showed that harvest index (%) was significantly influenced by sowing methods (Table 4.1). The highest harvest index was obtained from the line sowing method (31.10 %) followed by broadcasting (28.60%) and the lowest (27.05%) was recorded from dibbling. Caliskan et al. (2004) also found that harvest index significantly influenced by sowing method and is slightly increased by line sowing. Islam (2017) found that significant variation was found on harvest index influenced by sowing methods of sesame and the highest harvest index (42.67%) was obtained from the line sowing method and the lowest (39.91%) was found from broadcasting. Khanam et al. (2022) reported that the biological yield and harvest index were significantly affected by sowing methods. The higher biological yield was found in line sowing and the lower biological yield was observed in broadcast sowing. Broadcast sowing had a lower harvest index (29.87%) while line sowing had a greater one (31.45%). However, Islam (2008) reported that method of sowing had no significant influence on harvest index.

4. 13. 2 Effect of Nitrogen

The present research showed that harvest index was significantly influenced by nitrogen rates (Table 4.2). The highest harvest index was obtained from the nitrogen rate of 45 kg ha⁻¹ (33.60%) followed by 30 kg N ha⁻¹ (30.33%). The lowest harvest index (24.89%) was recorded from control. Adequate supply of nitrogen is advantageous for both carbohydrates and protein metabolism since it encourages cell proliferation and expansion, resulting in higher leaf area and so ensuring good seed and dry matter output. When a larger dose of N (90 kg ha⁻¹) was applied, harvest index was highest. Similarly, the lowest harvest index was reported in control plots (Ibrahim et al., 2014). Ali et al. (2014) found that plots supplied with nitrogen had significantly higher harvest index as compared to control plots. With increase of nitrogen level harvest index increased significantly and therefore the highest level of nitrogen (120 kg ha⁻¹) produced maximum harvest index (15%) while lowest (10%) harvest index was recorded in control plots. These results are consistent with those of Shehu et al. (2010), who found that the harvest index increased significantly with increasing nitrogen application rate above other rates of application and control plots.

4. 13.3 Interaction Effect of Nitrogen and Sowing Method

The present finding showed that harvest index was significantly influenced by the interaction of sowing methods and nitrogen rates as shown in Table 4.4. S_2N_3 produced the highest seed weight per plant (36.48%) was statistically similar to S_2N_2 and all other treatments. S_1N_3 produced the lowest seed/plant and S_1N_2 , S_2N_1 and S_2N_2 were statistically similar. S_1N_0 , S_1N_1 , S_2N_0 , S_3N_0 and S_3N_1 were statistically similar.

4. 14 Relationship between Seed Weight/Plant (g) and Stover Weight/Plant (g)

When seed weight of BARI Til-6 was plotted against corresponding stover weight, a linear relation was found ($y = 0.6564x + 0.8471$, $R^2 = 0.94$). The seed weight/plant was positively related to stover weight/plant (Figure 1). The seed weight of sesame increased steadily with the increase of stover weight. The higher value of R^2 indicated that 94% in the variation in seed weight could be explained by the variation in stover weight.

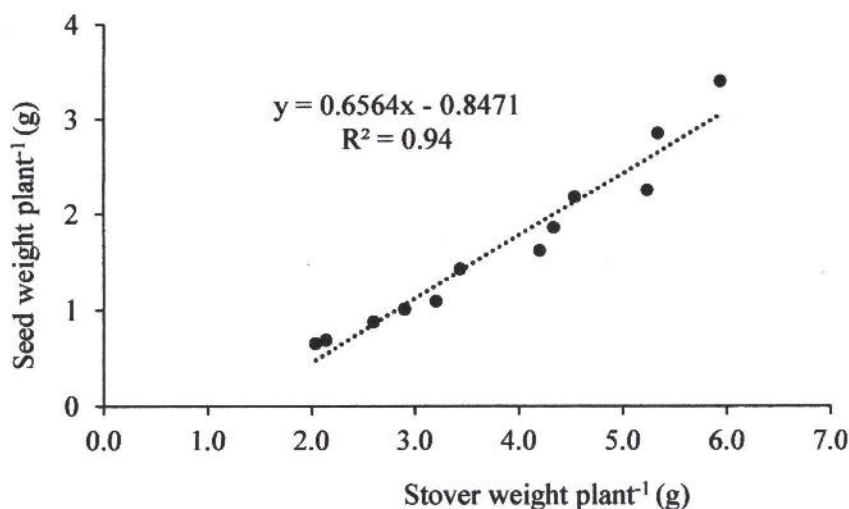


Figure 1: Relationship between seed weight/plant (g) and stover weight/plant (g) of BARI Til-6.

4. 15 Relationship between Seed Weight/Plant (g) and Harvest Index (%)

Plotting seed weight/plant of BARI Til-6 against harvest index (%) resulted a linear but positive relationship (Figure 2). The seed weight increased steadily with the increase of harvest index (%). It is worth noting that 96% of the variation in seed weight could be explained by the variation in harvest index (as per the equation of $y = -0.2093x - 4.3924$, $R^2 = 0.96$).

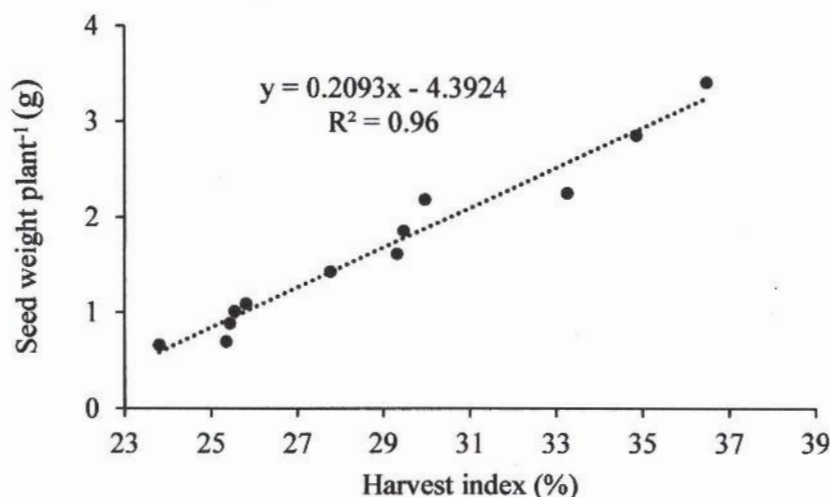


Figure 2: Relationship between seed weight/plant (g) and harvest index (%) of BARI Til-6.

4. 16 Relationship between Seed Weight/Plant (g) and Biological Yield (g)/Plant

The relationship between seed weight/plant and biological yield (g)/plant of was also found linear and positive (Figure 3). The seed weight (g)/plant increased steadily with the increase of biological yield (g)/plant. The linear relationship was estimated weak and only 6% of the variation in seed weight could be explained by the variation in biological yield of BARI Til-6 ($y = 0.1069x + 1.0756$, $R^2 = 0.069$).

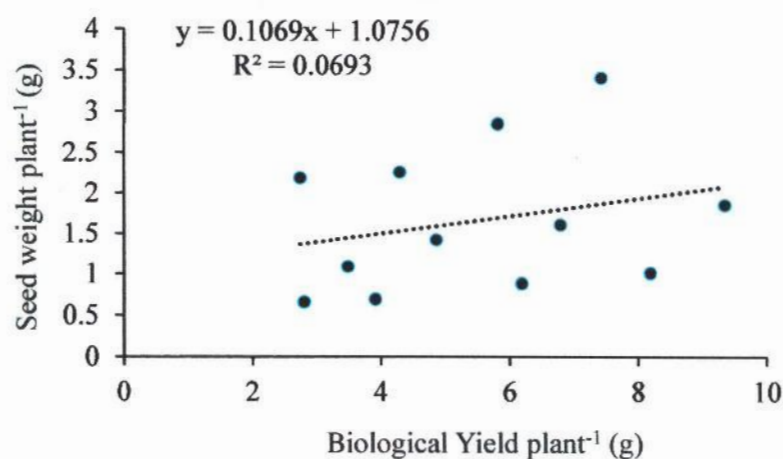


Figure 3: Relationship between seed weight/ plant (g) and biological yield/plant (g) of BARI Til-6.

Table 4.1. Effect of Sowing Method on Growth Parameters and Phenology of Sesame (BARI Til-6)

Sowing method		Broadcasting	Line sowing	Dibbling	SE ($\pm$)	P value	CV (%)
Parameters							
Plant height (cm)	35 DAS	20.67b	24.79a	19.79c	0.24	<0.01	2.70
	45 DAS	26.95b	32.38a	27.58b	0.36	<0.01	3.03
	55 DAS	35.52b	41.52a	36.20b	0.39	<0.01	2.55
	65 DAS	45.07b	51.39a	45.43b	0.36	<0.01	1.84
	75DAS	54.85b	60.90a	55.10b	0.54	<0.01	2.36
Branch/plant		1.97b	2.36a	1.93b	0.04	<0.01	5.75
First flowering (days)		36.58a	35.16b	36.42a	0.12	<0.01	0.82
Height of first capsule (cm)		25.872b	27.368a	26.510 b	0.3115	<0.01	2.87
Capsule length (cm)		1.80	1.78	1.74	0.02	NS	3.13
Capsule width (cm)		0.88a	0.89a	0.74b	0.02	<0.01	6.61
Capsule/plant		10.767b	13.033a	9.48c	0.24	<0.01	5.31
Seed/capsule		49.98b	52a	50.92ab	0.49	<0.01	2.39
Seed/plant		565.12b	708.33a	497.52 c	13.09	<0.01	15.43
1000-seed weight (g)		2.80	2.80	2.80	0.02	NS	1.89
Seed weight (g)/plant		1.59b	1.99a	1.39c	0.04	<0.01	6.47
Stover weight (g)/plant		3.67b	4.12a	3.66b	0.05	<0.01	3.77
Harvest index (%)		28.60b	31.10a	27.05c	0.49	<0.01	3.55

Here, SE indicate standard error, CV indicate coefficient of variation. The letter(s) having similar in a column indicate statistically similar while different letter indicate statistically dissimilar among the treatments.

Table 4.2. Effect of Nitrogen Rates on Growth Parameters and Phenology of Sesame (BARI Til-6)

Nitrogen (kg ha ⁻¹)		No nitrogen	15 (kg ha ⁻¹)	30 (kg ha ⁻¹)	45 (kg ha ⁻¹)	SE (±)	P value	CV (%)
Parameters								
Plant height (cm)	35 DAS	12.538d	17.558c	24.823b	32.081a	0.27	<0.01	2.7
	45 DAS	19.26d	24.72c	32.57b	39.32a	0.41	<0.01	3.03
	55 DAS	27.72d	33.88c	41.41b	47.96a	0.45	<0.01	2.55
	65 DAS	36.04d	44.10c	51.43b	57.62a	0.41	<0.01	1.84
	75DAS	42.67d	54.23c	62.92b	67.99a	0.63	<0.01	2.36
Branch/plant		1.37d	1.75c	2.31b	2.91a	0.05	<0.01	5.75
First flowering (days)		37.33a	36.88b	35.00c	35.00c	0.14	<0.01	0.82
Height of first capsule (cm)		25.12b	25.57b	27.82a	27.80a	0.35	<0.01	2.87
Capsule length (cm)		1.54d	1.73c	1.86b	1.98a	0.02	<0.01	3.13
Capsule width (cm)		0.70c	0.80b	0.91a	0.93a	0.02	<0.01	6.61
Capsule/plant		6.51d	8.57c	12.73b	16.55a	0.27	<0.01	5.31
Seed/capsule		41.48d	49.08c	54.13b	59.15a	0.57	<0.01	2.39
Seed/plant		270.22d	421.44 c	687.20b	982.42a	15.121	<0.01	5.43
1000-seed weight (g)		2.76b	2.78b	2.77b	2.87a	0.02	<0.01	1.89
Seed weight/plant (g)		0.74d	1.17c	1.90b	2.81a	0.05	<0.01	6.47
Stover weight/plant (g)		2.25d	3.17c	4.35b	5.50a	0.06	<0.01	3.77
Harvest index (%)		24.89d	26.85c	30.33b	33.60a	0.57	<0.01	3.55

Here, SE indicate standard error, CV indicate coefficient of variation. The letter(s) having similar in a column indicate statistically similar while different letter indicate statistically dissimilar among the treatments.

Table 4. 3. Interaction Effect of Sowing Method and Nitrogen on Plant Height, Branch Plant⁻¹, First Flowering (days) and Height of First Capsule (cm) of Sesame (BARI Til-6)

Sowing method and Nitrogen rate (kg ha ⁻¹)	Plant height (cm)					Branch /plant	First flowering (days)	Height of first capsule (cm)
	35 DAS	45 DAS	55 DAS	65 DAS	75 DAS			
S ₁ N ₀	12.36g	18.76e	30.70d	33.53i	40.34f	1.13f	38.33a	23.70d
S ₁ N ₁	15.52f	22.17d	26.90e	40.45fg	51.11e	1.40ef	38.00a	23.73d
S ₁ N ₂	23.47d	29.58c	39.74c	52.60cd	62.74cd	2.33bc	35.00b	27.00abc
S ₁ N ₃	31.32bc	37.29b	44.74b	53.70c	65.22bc	3.00a	35.00b	29.05a
S ₂ N ₀	13.01g	20.52de	29.14de	38.41gh	44.23f	1.73de	35.66b	25.30cd
S ₂ N ₁	23.34d	29.48c	39.82c	50.66d	60.15d	2.00cd	35.00b	27.94ab
S ₂ N ₂	29.61c	37.56b	45.29b	54.88c	67.04b	2.60b	35.00b	28.26ab
S ₂ N ₃	33.22a	41.95a	51.81a	61.62a	72.18a	3.13a	35.00b	27.96ab
S ₃ N ₀	12.23g	18.51e	27.13e	36.18h	43.44f	1.26f	38.00a	26.38bc
S ₃ N ₁	13.81fg	22.52d	31.13d	41.20f	51.42e	1.86d	37.66a	25.05cd
S ₃ N ₂	21.38e	30.56c	39.20c	46.81e	58.98d	2.00cd	35.00b	28.20ab
S ₃ N ₃	31.72ab	38.74b	47.34b	57.55b	66.56bc	2.60b	35.00b	26.39bc
SE (±)	0.48	0.71	0.78	0.70	1.09	0.09	0.24	0.62
P value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CV (%)	2.70	3.03	2.55	1.84	2.36	5.75	0.82	2.87

Here, SE indicate standard error, CV indicate coefficient of variation. The letter(s) having similar in a column indicate statistically similar while different letter indicate statistically dissimilar among the treatments. Here, S₁= Broadcasting, S₂= Line sowing, S₃= Dibbling, N₀= 0 kg/ha, N₁= 15 kg/ha, N₂= 30 kg/ha and N₃= 45 kg/ha.

Table 4.4. Interaction Effect of Sowing Method and Nitrogen on Capsule Length, Capsule Width, Capsule/ Plant, Seed/ Capsule, Seed/Plant, 1000-Seed Weight (g), Seed Weight/ Plant, Stover Weight/ Plant and Harvest Index of Sesame (BARI Til-6)

Sowing method Nitrogen rate (kg ha ⁻¹)	Capsule length (cm)	Capsule width (cm)	Capsule / plant	Seed/ capsule	Seed/ plant	1000-seed weight (g)	Seed weight/ Plant (g)	Stover weight / Plant (g)	Harvest index (%)
S ₁ N ₀	1.58ef	0.73	5.86i	41.40f	242.9g	2.76	0.66h	2.13g	23.79f
S ₁ N ₁	1.76bcd	0.87	7.73gh	46.73e	360.1f	2.80	1.01fg	2.90ef	25.80def
S ₁ N ₂	1.853b	0.94	12.33de	53.73cd	662.2 d	2.80	1.85d	4.33c	29.96bc
S ₁ N ₃	2.02a	0.98	17.13b	58.06ab	995.3b	2.86	2.85b	5.33b	34.85a
S ₂ N ₀	1.60de	0.76	7.60ghi	42.00f	318.7fg	2.76	0.88fgh	2.60f	25.34ef
S ₂ N ₁	1.65cde	0.85	10.13f	50.26de	509.5e	2.80	1.42e	3.43d	29.32cd
S ₂ N ₂	1.86ab	0.96	15.13c	54.06c	816.3c	2.76	2.25c	4.53c	33.25ab
S ₂ N ₃	2.02a	0.98	19.26a	61.66a	1188.8a	2.8	3.40a	5.93a	36.48a
S ₃ N ₀	1.43f	0.68	6.06hi	41.06f	249.1g	2.80	0.69gh	2.03g	25.54ef
S ₃ N ₁	1.78bc	0.62	7.86g	50.26de	394.7f	2.76	1.09f	3.20de	25.43ef
S ₃ N ₂	1.86ab	0.83	10.73ef	54.60bc	583.1de	2.76	1.61de	4.20c	27.77cde
S ₃ N ₃	1.91ab	0.84	13.26d	57.73b	763.2c	2.86	2.18c	5.23b	29.47c
SE(±)	0.04	0.04	0.48	0.99	26.10	0.04	0.08	0.11	0.99
P value	<0.01	NS	<0.01	<0.05	<0.01	NS	<0.01	<0.05	<0.01
CV (%)	3.13	6.61	5.31	2.39	5.43	1.89	6.47	3.77	3.55

Here, SE indicate standard error, CV indicate coefficient of variation. The letter(s) having similar in a column indicate statistically similar while different letter indicate statistically dissimilar among the treatments. Here, S₁= Broadcasting, S₂= Line sowing, S₃= Dibbling, N₀= 0 kg/ha, N₁= 15 kg/ha, N₂= 30 kg/ha and N₃= 45 kg/ha.



Chapter V

Summary, Conclusion and Recommendation

A field study was carried out at the Regional Inspection Center (RIC), Bangladesh Meteorological Department, Gollamari, Khulna during the period from February 2024 to May, 2024 to examine the effect of sowing methods and nitrogen rates on the growth and yield performance of sesame (BARI Til-6). The experiment comprised of four nitrogen doses viz. 0, 15, 30 and 45 kg ha⁻¹ and three sowing methods viz. broadcasting, line sowing and dibbling as treatment. The experiment was piloted out in a Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 3 m² (2 m x 1.5 m). Data were on recorded for various growth plant characters and yield attributes at harvest. All the gathered data were analyzed statistically and mean differences were adjudged by Tukey's HSD test.

Experimental results indicate that all the yield contributing and plant characters viz. plant height, number of branches/plant, first flowering, capsule width, number of capsules/plant, number of seeds/capsule, number of seeds/plant, seed weight/plant, stover weight/plant and harvest index varied significantly by different sowing methods except the capsule length and 1000 seed weight.

Line sowing rendered the highest plant height (60.90 cm), number of branches plant (2.36), capsule width (0.89 cm), number of capsules/plant (13.03), number of seeds/capsule (52), number of seeds/plant (708.33), seed weight/plant (1.99 g), stover weight/plant (4.12 g), harvest index (31.10%) and time to first flowering (35.16 days). The lowest value of plant height (54.84 cm) and seed/capsule (45.98) was obtained from broadcasting. The lowest number of branches plant (1.93), the shortest capsules (1.74 cm), narrower capsules (0.74 cm), minimum number of capsules/plant (9.48), fewer seeds/plant (497.50), lighter seed weight/plant (1.39 g), lower stover weight/plant (3.66 g) and inferior harvest index (27.05 %) were found in dibbling.

The tallest plants (69.99 cm), more number of branches plant (2.91), longer capsules (1.98 cm), capsule with larger width (0.93 cm), higher number of capsules/plant (16.55), premium number of seeds/capsule (59.15), higher number of seeds/plant (982.42), 1000 seed weight (2.87 g), superior seed weight/plant (2.81 g), greater stover weight/plant (5.50 g) and maximum harvest index (33.60%) were obtained from 45 kg N/ha. The shortest time span for flowering (35 days) was noticed from both 30 and 45 kg N/ha.

The shortest plants (42.67 cm), less number of branches/plant (1.37), smaller capsules (1.54 cm), narrower capsules (0.70 cm), inferior number of capsules/plant (6.51), fewer number of seeds/capsule (41.48), minimum number of seeds/plant (270.22), smaller seed weight/plant (0.74 g), stover weight/plant (2.25 g) and lower harvest index (24.89 %) were found from control.

Interaction between sowing methods and nitrogen rates significantly influenced all the plant growth and yield contributing characters except the capsule width and 1000-seed weight. Combination of line sowing and 45 kg N/ha produced the tallest plants (72.18 cm), more branches/plant (3.13), more capsule/plant (19.26), higher number of seed/capsule (61.66), higher seed/plant (1188.8), heavier seeds/plant (3.40 g), maximum 'stover weight/plant (5.93 g) and superior harvest index (36.48%). Combination of broadcasting and line sowing with 45 kg N/ha produced the maximum capsule length (2.02 cm) and width (0.98 cm). The findings of the present study indicate that line sowing and 45 kg N/ha performed best in the coastal region of southwestern Bangladesh for sesame growth and yield.

There is generous scope for sesame cultivation in Bangladesh. The government should ensure that quality seed is supplied at the appropriate time and at a reasonable price, as well as limit the supply and availability of contaminated fertilizer on the market. More attention should be placed on generating new types with shorter durations, stress tolerance, and other qualities. Farmers, extension officials, and sesame growers, all are required to interact often. It is also crucial for sesame farmers to receive timely instruction in improved sesame cultivation and crop management practices. Increasing the area and productivity of sesame is a crucial aspect of attaining Bangladesh's self-sufficiency in oilseed production (Islam et al., 2022).

The present investigation was done in the coastal soil of southwestern Bangladesh. Therefore the outputs of the study do not provide a common picture of the growth and yield of sesame for the whole country. To generalize the findings, similar research needs to be conducted in several other parts of the country. Future studies may be undertaken urgently as because the performance of nitrogen and sowing methods may vary from place to place and season to season in Bangladesh.

Chapter VI

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AGRO-ECOLOGICAL ZONES BANGLADESH

0 10 20 30 KILOMETERS

N

Legend:

1 Old Brahmaputra-Padma River Floodplain	13 Barisal	23 Barind Tract
2 Active Low Floodplain	14 Barisal	24 Barind Tract
3 Tista-Meghna Floodplain	15 Barisal	25 Barind Tract
4 Sarai-e-Munshiganj Floodplain	16 Barisal	26 Barind Tract
5 Lower Atia River	17 Barisal	27 Barind Tract
6 Upper Padma-Brahmaputra Floodplain	18 Barisal	28 Barind Tract
7 Active Brahmaputra-Jamuna Floodplain	19 Barisal	29 Barind Tract
8 Young Brahmaputra-Jamuna Floodplain	20 Barisal	30 Barind Tract
9 Old Brahmaputra Floodplain	21 Barisal	31 Barind Tract
10 Active Ganges Floodplain	22 Barisal	32 Barind Tract
11 High Ganges River Floodplain	23 Barisal	33 Barind Tract
12 Low Ganges River Floodplain	24 Barisal	34 Barind Tract
13 Ganges-Labai Floodplain	25 Barisal	35 Barind Tract
14 Ganges-Labai Floodplain	26 Barisal	36 Barind Tract
15 Ganges-Labai Floodplain	27 Barisal	37 Barind Tract
16 Ganges-Labai Floodplain	28 Barisal	38 Barind Tract
17 Ganges-Labai Floodplain	29 Barisal	39 Barind Tract
18 Ganges-Labai Floodplain	30 Barisal	40 Barind Tract
19 Ganges-Labai Floodplain	31 Barisal	41 Barind Tract
20 Ganges-Labai Floodplain	32 Barisal	42 Barind Tract
21 Ganges-Labai Floodplain	33 Barisal	43 Barind Tract
22 Ganges-Labai Floodplain	34 Barisal	44 Barind Tract
23 Ganges-Labai Floodplain	35 Barisal	45 Barind Tract
24 Ganges-Labai Floodplain	36 Barisal	46 Barind Tract
25 Ganges-Labai Floodplain	37 Barisal	47 Barind Tract
26 Ganges-Labai Floodplain	38 Barisal	48 Barind Tract
27 Ganges-Labai Floodplain	39 Barisal	49 Barind Tract
28 Ganges-Labai Floodplain	40 Barisal	50 Barind Tract
29 Ganges-Labai Floodplain	41 Barisal	51 Barind Tract
30 Ganges-Labai Floodplain	42 Barisal	52 Barind Tract
31 Ganges-Labai Floodplain	43 Barisal	53 Barind Tract
32 Ganges-Labai Floodplain	44 Barisal	54 Barind Tract
33 Ganges-Labai Floodplain	45 Barisal	55 Barind Tract
34 Ganges-Labai Floodplain	46 Barisal	56 Barind Tract
35 Ganges-Labai Floodplain	47 Barisal	57 Barind Tract
36 Ganges-Labai Floodplain	48 Barisal	58 Barind Tract
37 Ganges-Labai Floodplain	49 Barisal	59 Barind Tract
38 Ganges-Labai Floodplain	50 Barisal	60 Barind Tract
39 Ganges-Labai Floodplain	51 Barisal	61 Barind Tract
40 Ganges-Labai Floodplain	52 Barisal	62 Barind Tract
41 Ganges-Labai Floodplain	53 Barisal	63 Barind Tract
42 Ganges-Labai Floodplain	54 Barisal	64 Barind Tract
43 Ganges-Labai Floodplain	55 Barisal	65 Barind Tract
44 Ganges-Labai Floodplain	56 Barisal	66 Barind Tract
45 Ganges-Labai Floodplain	57 Barisal	67 Barind Tract
46 Ganges-Labai Floodplain	58 Barisal	68 Barind Tract
47 Ganges-Labai Floodplain	59 Barisal	69 Barind Tract
48 Ganges-Labai Floodplain	60 Barisal	70 Barind Tract
49 Ganges-Labai Floodplain	61 Barisal	71 Barind Tract
50 Ganges-Labai Floodplain	62 Barisal	72 Barind Tract
51 Ganges-Labai Floodplain	63 Barisal	73 Barind Tract
52 Ganges-Labai Floodplain	64 Barisal	74 Barind Tract
53 Ganges-Labai Floodplain	65 Barisal	75 Barind Tract
54 Ganges-Labai Floodplain	66 Barisal	76 Barind Tract
55 Ganges-Labai Floodplain	67 Barisal	77 Barind Tract
56 Ganges-Labai Floodplain	68 Barisal	78 Barind Tract
57 Ganges-Labai Floodplain	69 Barisal	79 Barind Tract
58 Ganges-Labai Floodplain	70 Barisal	80 Barind Tract
59 Ganges-Labai Floodplain	71 Barisal	81 Barind Tract
60 Ganges-Labai Floodplain	72 Barisal	82 Barind Tract
61 Ganges-Labai Floodplain	73 Barisal	83 Barind Tract
62 Ganges-Labai Floodplain	74 Barisal	84 Barind Tract
63 Ganges-Labai Floodplain	75 Barisal	85 Barind Tract
64 Ganges-Labai Floodplain	76 Barisal	86 Barind Tract
65 Ganges-Labai Floodplain	77 Barisal	87 Barind Tract
66 Ganges-Labai Floodplain	78 Barisal	88 Barind Tract
67 Ganges-Labai Floodplain	79 Barisal	89 Barind Tract
68 Ganges-Labai Floodplain	80 Barisal	90 Barind Tract
69 Ganges-Labai Floodplain	81 Barisal	91 Barind Tract
70 Ganges-Labai Floodplain	82 Barisal	92 Barind Tract
71 Ganges-Labai Floodplain	83 Barisal	93 Barind Tract
72 Ganges-Labai Floodplain	84 Barisal	94 Barind Tract
73 Ganges-Labai Floodplain	85 Barisal	95 Barind Tract
74 Ganges-Labai Floodplain	86 Barisal	96 Barind Tract
75 Ganges-Labai Floodplain	87 Barisal	97 Barind Tract
76 Ganges-Labai Floodplain	88 Barisal	98 Barind Tract
77 Ganges-Labai Floodplain	89 Barisal	99 Barind Tract
78 Ganges-Labai Floodplain	90 Barisal	100 Barind Tract
79 Ganges-Labai Floodplain	91 Barisal	101 Barind Tract
80 Ganges-Labai Floodplain	92 Barisal	102 Barind Tract
81 Ganges-Labai Floodplain	93 Barisal	103 Barind Tract
82 Ganges-Labai Floodplain	94 Barisal	104 Barind Tract
83 Ganges-Labai Floodplain	95 Barisal	105 Barind Tract
84 Ganges-Labai Floodplain	96 Barisal	106 Barind Tract
85 Ganges-Labai Floodplain	97 Barisal	107 Barind Tract
86 Ganges-Labai Floodplain	98 Barisal	108 Barind Tract
87 Ganges-Labai Floodplain	99 Barisal	109 Barind Tract
88 Ganges-Labai Floodplain	100 Barisal	110 Barind Tract
89 Ganges-Labai Floodplain	101 Barisal	111 Barind Tract
90 Ganges-Labai Floodplain</		

Source: Google.com

Appendix B

Chemical Characteristics of the Experimental Soil (0-15 cm depth) Before Seed Sowing

Properties	Value	Class
pH	8.20	Slightly alkaline
Salinity (dS/m)	7.50	Moderately Saline
Organic matter (%)	3.67	High
Nitrogen (%)	0.18	Low
Phosphorus (μ g/ g of soil)	46.27	Very high
Potassium (μ g/ g of soil)	0.25	Moderate
Sulfur (μ g/ g of soil)	52. 15	Very high
Zinc (μ g/ g of soil)	0.62	Low
Boron (μ g/ g of soil)	1. 12	Very high

Source: SRDI, Khulna, Bangladesh

