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## Comparative study of sunflower varieties in Bangladesh's coastal region

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### ABSTRACT

*In addition to its high oil content (40–50%), excellent adaptability, and 23% protein content, sunflower (*Helianthus annuus* L.) is one of the most nutritious edible oil seed crops in the world. In order to ascertain the morphological traits of the different sunflower varieties in the Noakhali region, an experiment utilizing a randomized block design with three replications was carried out in the NSTU Agricultural field in Noakhali from May to September 2019. The types were gathered from the Noakhali district's Department of Agriculture Extension (DAE). The findings showed that every sunflower variety examined differed considerably in every one of the features. All of the characteristics of the various sunflower types showed minimum variations in phenotypic variances and coefficient of variation in percent of mean. In BARI Surjamukhi 2, the earliest flowering date (54.77 DAS) was noted. BARI Surjamukhi 2 had the most leaves per plant of any recorded (20.6), followed by Kironi DS 1 (19.53). The maximum head diameter was recorded (17.3 cm) in BARI Surjamukhi 2, followed by Kironi DS 1 (16.67 cm). The maximum plant height was recorded (146.23 cm) in Hy sun 33. The second highest plant height (139.6 cm) in BARI Surjamukhi 2. The variety BARI Surjamukhi 2 fared the best in terms of days till first flowering, number of leaves per plant, head diameter, and number of seeds per head. After Hy sun33, Kironi DSI yielded a second-higher yield. After comparing three different types of sunflower, it was determined that BARI Surjamukhi 2 yielded the highest, followed by Kironi DSI and Hy sun 33. BARI Surjomukhi 2 showed positive traits regarding head diameter, number of leaves, number of seeds and days to first flowering. So, the study suggests that farmers in the Noakhali region could benefit from cultivating BARI Surjomukhi 2 to maximize their profits in Bangladesh's context.*

**Key Words:** Sunflower, Morphological characteristics, Yield variability, Varieties and Coastal region.

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## I. Introduction

Sunflower (*Helianthus annuus* L.) is a non-conventional oilseed crop consumed worldwide. After soybeans, sunflowers are the world's fourth-largest edible source, with about 23 million hectares planted worldwide (Abro et al., 2020). The Asteraceae family includes it. According to Andrew et al. (2013), there are 65 species in the genus *Helianthus*, 14 of which are annual plants. Sunflower is also known as Surjamukhi. It is a significant crop in parts of Asia (Bangladesh, India, Nepal and Pakistan). As one of the major oils and the fourth most produced worldwide, sunflower seeds are used for food and their dried stalks are used for fuel. The increased oil content in sunflower seeds is a result of the production of more glucoside, which produces sulfur-rich amino acids like cysteine and methionine, and the subsequent production of amino acids that ultimately increase the quantity of oil in the seeds (Halim et al., 2023). Sunflower is a popular and widely used oil in Bangladesh that is connected to the social, cultural and economic lives of rural people. According to Harter et al. (2004) and Muller et al. (2011), sunflowers have long been employed in ceremonial contexts as decorative plants. As per Blackman et al. (2011), the sunflower originated in eastern North America. Although sunflowers can be grown in a variety of soil types, they thrive in soils that are nearly neutral in pH (6.5–7.5), well-drained and have a good water-holding capacity.

All types of soils are suitable for growing sunflowers (Radanielson et al., 2012). However, loamy soil works well for growing this crop. The ideal temperature range for seed development is between 20°C to 25°C and the flower has a tendency to cross-pollinate (Thomaz et al., 2012). As little as 300 mm of rain can provide modest yields from sunflowers; greater yields require 500–750 mm of rain annually (Gholamhoseini et al., 2013; Ghaffari et al., 2012). At intermediate temperatures, photosynthetic rate is high (Hikosaka et al., 2006). It is generally an annual plant with a large inflorescence, or flowering head and a name derived from the form of the flower. The plant features round flower heads, massive, rigid leaves with hard teeth and a rough, bushy stem (Khaleghizadeh, 2011). On a receptacle base, the heads produced several individual blooms that eventually developed into seeds (Seghatoleslami et al., 2012). Sunflower cultivation is growing in the saline lands of chars on the coast of Noakhali. In the current season, the grand golden sunflower commemorates across the broad field of each union of charbata, char Aman ullah, char Jabbarand Char Wadapas of subarnachar upazila of the district. The cultivated sunflower, in all likelihood, originated in Mexico. In Bangladesh, it was first introduced as a garden plant, but in the 1980s, some dwarf sorts have been delivered to domesticate as oil seed crops. The plant is now cultivated as Kharif and rabi crops in some central and northern districts. As per Chigeza et al. (2013), Khan et al. (2013), Akhtar et al. (2012), the yield varies by up to 600–3000 kg per hectare. According to Kara et al. (2013), this plant has been extensively researched for its potential in heavy metal phytoremediation. Fatty acid composition of sunflower crops ranges from 55-75% linoleic acid to 15-25% oleic acid, with 15-20% protein (Aznar et al., 2013 and Ali and Ullah et al., 2012). Since linoleic acid, which makes up around 50% of the polyunsaturated fatty acids in sunflower oil, is particularly abundant there, it has lower saturated fat content than other types of oil (Ramadan, 2013).

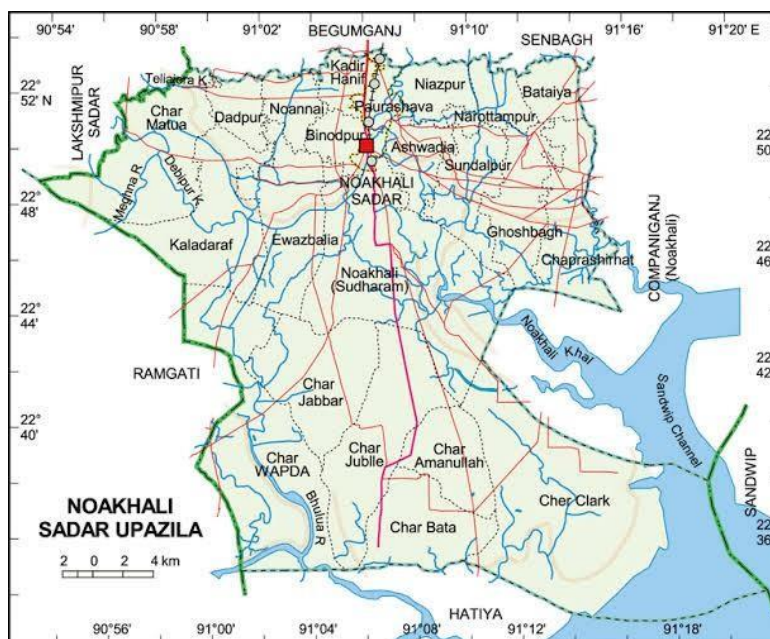
Many sunflower varieties (surjamukhi) are available for cultivation in Bangladesh. Most cultivable varieties of Bangladesh are BARI Surjamukhi 2, Kironi DS-1, High Sun-33 etc. Bangladesh Agriculture Research Institute (BARI) created BARI Surjamukhi-2. It may be found at Gazipur. This variety emerged by a process of open pollination and selection. Plant height of 125-140 cm, radium 2.0-2.4 cm, ripen inflorescence of head radium 15-18 cm, black seed color, number of seeds/head 450-650, days of flowering 57-65 days, crop duration in rabi season 95-100 days and kharif season 85-90 days, and sowing time from January to April are the main characteristics of this variety. Bangladesh Agriculture Research Institute (BARI) developed the Kironi DS-1. This variety was released in 1983. Plant breeding aims to produce cultivars with a wide range of adaptations, higher yield, desirable quality and resistance to pests and diseases. To achieve these different goals, we must assess the current genotypes at phenotypic levels. The performance and genotypic diversity of sunflower genotypes for yield and yield-contributing traits are examined in this study in light of the aforementioned facts.

## II. Materials and Methods

### Experimental site

The study was carried out between May and September of 2019. The experiment was conducted in "NSTU Agricultural field" in Noakhali, Bangladesh. Figure 01 shows the location of the experimental

site on the map of Bangladesh's AEZ. Over five months, the mean warmest and lowest temperatures were 32.5°C and 23.67°F, respectively. The Weather Station, Maijdee and Noakhali provided the climate data.



**Figure 01. Map showing the experimental site under the study**

### Experimental design

The experiment was laid out with three (3) replications. Every replication has 15 plants of BARI Surjomukhi 2, Kiron DS 1 and Hy sun 33. The spacing was 50 cm X 25 cm.

### Agro-ecological region

The experiment field is located in the Young Meghna Estuarine Floodplain's agro-ecological zone (AEZ-18) which adjacent to the Meghna Estuary and is comprised of young alluvial soils. With wide depressions and very low ridges, it is nearly level. Soil characteristics of the experimental plot Young Meghna Estuarine Floodplain, top soil was silty in texture. Soil pH was 8.3 and had organic carbon 0.68%. The soils become saline in dry season. The experimental location was above flood level, flat and equipped with an irrigation and drainage system. The chosen plot was a medium-high land area.

### Experiment Materials

The seeds of the sunflower varieties were collected from the Department of Agricultural Extension, Noakhali, sadar upazilla, Noakhali. The following varieties were collected: BARI Surjomukhi 2, Kiron DS 1, Hy sun 33.

### Parameters Studied

In the study, morphological performances of sunflowers were observed. The parameters are enlisted as follows: Days of seed emergence, Days of first flowering, Plant height (cm), Number of leaves plant<sup>-1</sup>, Head diameter (cm), Number of seed head<sup>-1</sup>.

### Raising of seedlings

The sunflower seedlings were cultivated in 3.0 m x 1.0 m seedbeds. The seedbed requires well-prepared, friable soil that has been dried. After removing all weeds and stubble, the soil was combined with well-rotted cow dung. On May 12, 2018, seeds were sowed in each seedbed. The seeds were covered with light dirt after they were sown. Six to seven days after seeding, the seedlings began to appear. We removed weeds as soon as they developed and irrigated the seedbeds as needed to ensure they were similarly healthy.

### Land preparation

During the final week of May 2018, the experiment plot was prepared by breaking it with a hand spade and exposing it to the sun for a week. After a week, the field was laddered to produce good tilth and

then repeatedly ploughed, cross-ploughed, and harrowed. After eliminating weeds and stubbles, a suitable surface was attained for transplanting sunflower seedlings. In line with the experiment's concept, the experimental plot was divided into unit blocks. Each unit plot's soil was combined with cow dung and artificial fertilizers, as shown below. Application of fertilizers and manure

Application of urea, TSP, MOP, gypsum and ZnSO<sub>4</sub>, etc. Following is a list of the fertilizers that were applied to sunflowers. The fertilizers were applied correctly during the final land preparation: 15 kilogram of cow dung, 0.6 kg of urea, 1.2 kg of TSP, 0.75 kg of MoP, and 0.75 kg of cow dung per hectare. After raising seedlings for 20–25 days, the remaining urea was applied in two equal installments, and then again for 40–50 days.

### **Purification of Seed**

Seed purification is essential for resistance to soil and seed-borne diseases. Sunflower seeds were purified by the application of vitavox 200.

### **Transplanting of seedlings**

In the afternoon of June 15, uniform and healthy sunflower seedlings were removed from the seed bed and placed in the experimental plots, leaving 50 cm between plants and 100 cm between rows. As a result, each plot could accommodate 25 plants. To prevent causing damage to the roots, the seedbed was irrigated before the seedlings were removed.

### **Intercultural operation**

**Weed management:** Weeding was done as and when necessary. In the field, some weeds were found, which were removed. Weeding was performed in several periods separated by two weeks.

**Thinning:** Emergence of seedlings was completed within ten days after sowing. Overcrowded seedling was thinned out. This act was accomplished before using Urea.

**Irrigation and drainage:** Irrigation and drainage were done as and when necessary for over rainfall, water stagnant was created in the field.

**Gap filling:** Where the initial planter seedling failed to live, a healthy seedling of the same variety filled the gap. Gap filling was done in the afternoon.

**Spraying of pesticide:** Ripcode 10 EC was applied at 1ml/L to check for insect attacks when necessary.

### **Statistical analysis**

The data collected for the various characteristics under the current experiment were statistically analyzed to examine the sunflower varieties in relation to yield-contributing characteristics and yield. An analysis of variance was conducted and the mean values of each character were obtained.

## **III. Results and Discussion**

### **Leaf color and**

Variation in leaves of different varieties of sunflower ranges from light green to dark green ([Table 01](#)).

### **Flower color**

Flower color is one of the important traits. Generally, bright yellow and lightly radish colors common. It was discovered that there were many variations in flower color, which could be categorized as copper, red, brown, orange, bright yellow with brown centers and bi-colored flowers. BARI Surjamukhi 2 showed bright yellow color and Hy sun 33 showed light yellow color ([Table 01](#))

### **Flower shape**

Sunflower shape is mostly round ([Table 01](#)).

**Table 01. Characterization of 3 varieties of sunflower as per flower and leaf color**

Varieties	Leaf color	Flower color	Flower shape
BARI Surjomukhi 2	Light green	Bright yellow	Round
Kironi DS 1	Green	Bright yellow	Round
Hy sun 33	Dark green	Light yellow	Round

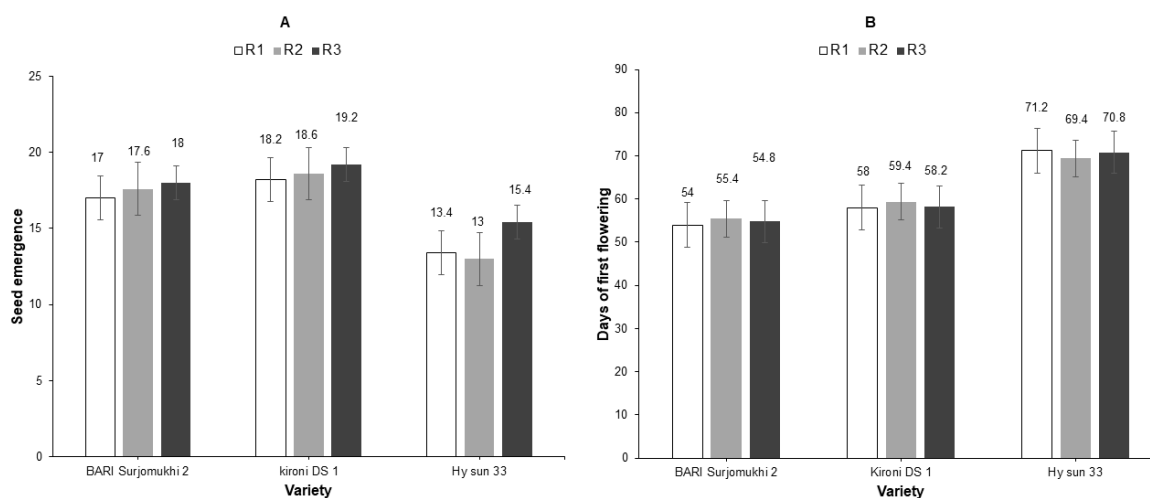
## Performance of Varieties

### Days taken to emergence

A wide range of variability was observed concerning emergence time among the genotypes. As can be seen in the graph, there were considerable differences in the amount of time required for the various hybrids to emerge. Hybrid Hy Sun 33 took a shorter period of time to emerge (13.93 days) and the Kironi DS 1 took the longest (18.67 days) (Figure 02A). Ahmed et al. (2015) reported that BARI Surjamukhi 2 required 20 days for seed emergence. Similar results that have been reported by Amjed al. (2013) were observed that Hy sun 33 emergences in 9 days and Hy sun 38 emergences in 10 days. Bakht's (2006) findings are supported by the results obtained.

### Days of first flowering

Data regarding mean values showed a wide variation on the day of first flowering among the studied varieties. From the observation, it was found that the variety Hy sun 33 required maximum days (70.47 days) for first flowering and BARI Surjamukhi 2 required minimum days (58.53 days) for first flowering (Figure 02B). The variations between the types may be attributed to temperature, day duration and the genetic makeup of the line. Similar results compared to those reported by Ahmed et al. (2015) were observed that BARI Surjamukhi 2 required (57days) for first flowering. Amjed al. (2013) observed that Hy sun 33 took (77.5 days) for first flowering and Hy sun 38 took (80 days) for first flowering. These findings partially agree with Akhtar's (1989) findings.



**Figure 02. Graphical representation of days taken to emergence and days taken for first flowering of different varieties**

R<sub>1</sub>= Replication 1, R<sub>2</sub>= Replication 2, R<sub>3</sub>= Replication 3

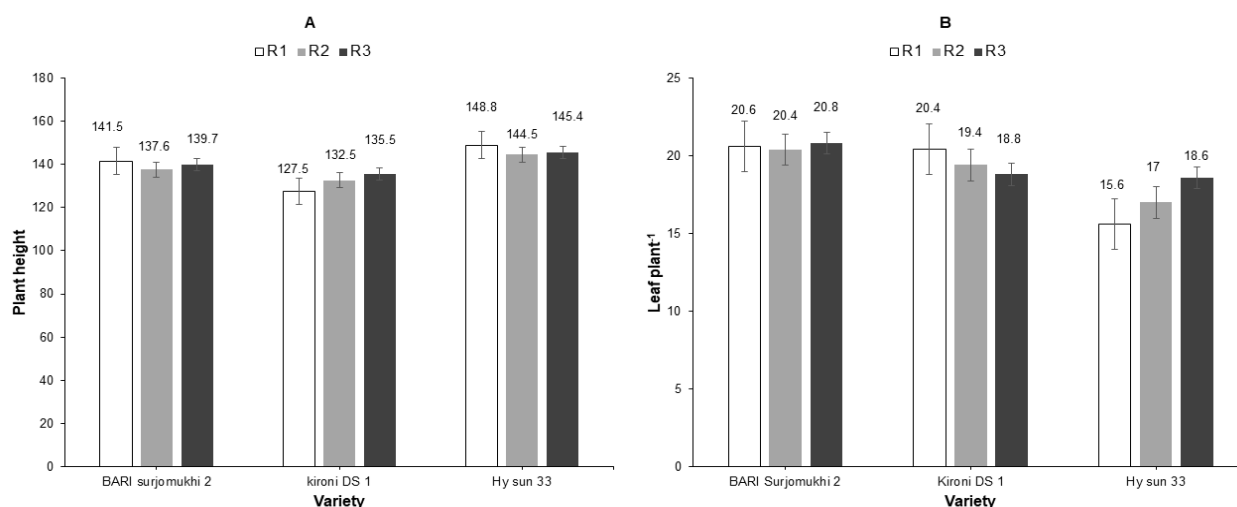
### Plant height (cm)

Different cultivars showed a wide range of differences in plant height. Average plant height for BARI Surjamukhi 2, Kironi DS 1, Hy sun 33 was 139.6 cm, 131.83 cm, 146.23 cm, respectively (Figure 03A). Hy sun 33 showed highest plant height and kironi DS 1 showed lowest plant height. The remaining BARI Surjamukhi 2 was intermediate in this regard. Similar findings recorded by Ahmed et al. (2015), mentioned that BARI Surjamukhi 2 showed the maximum plant height (172.13 cm). On the other hand, Amjed al. (2013) reported that hybrid Hy sun 33 and Hy sun 38 became maximum 213.1 cm and 210.12 cm, respectively. These conclusions agree with what was originally stated by Mazhar and Razzaq (2005).

### Number of leaf's plant<sup>-1</sup>

Data regarding mean values showed that there was a significant difference. Leaf number per plant between the studied varieties. Each plant's total number of leaves was recorded and the mean of those

numbers was determined. Based on the observation, it was discovered that the variety BARI Surjamukhi 2 produced the highest number of leaves (20.6) per plant and had the lowest number of leaves per plant produced (17.07) in Hy sun 33 (Figure 03B). The remaining BARI kironi DS 1 was intermediate in this regard and which is 19.53. Roy et al. (2008) stated that leaf number is dominant depending on both biotic and abiotic characteristics, as well as the genetic and physiological ready condition.



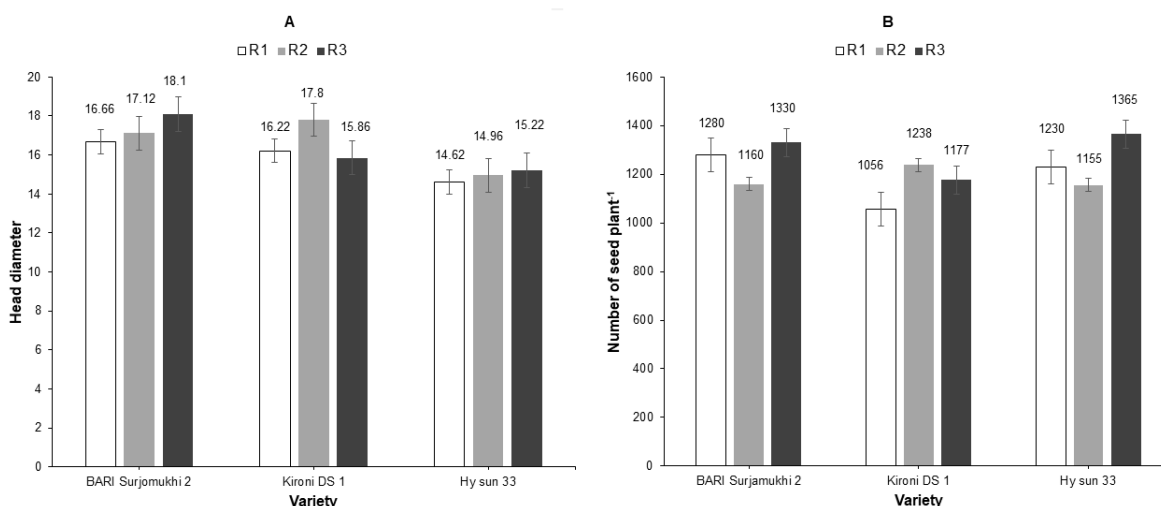
**Figure 03. Graphical representation of plant height and number of leaf plant<sup>-1</sup> of different varieties** R<sub>1</sub>= Replication 1, R<sub>2</sub>= Replication 2, R<sub>3</sub>= Replication 3

### Head diameter (cm)

A wide range of variability was observed concerning head diameter time among the genotypes. Average head diameter for BARI Surjamukhi 2, kironi DS 1, Hy sun 33 was 17.3 cm, 16.67 cm, 14.93 cm, respectively (Figure 04A). BARI Surjamukhi 2 produced highest head diameter and the lowest head diameter produced in Hy sun 33 variety. Similar findings have been recorded by Ahmed et al., (2015), who observed that BARI Surjamukhi 2 showed average head diameter (18.33 cm). Amjed et al. (2013) reported that Hy sun 33 produced the maximum head diameter (24 cm). These findings agree with the results reported by Waheed (1996).

### Number of seed plant<sup>-1</sup>

Data regarding mean values showed a wide variation number of seed per plant among the studied varieties. From the observation, it was found that the variety Hy sun 33 produced maximum number of seed (1290.67) and the minimum number of seed produced in kironi DS 1 which was (1184.33) (Figure 04B). The remaining BARI Surjamukhi 2 was intermediate in this regard and which was 1188.67. Amjed al. (2013) reported that Hy sun 33 produced 1775 seeds per head.



**Figure 04. Graphical representation of head diameter and number of seed plant<sup>-1</sup> of different varieties.** R<sub>1</sub>= Replication 1, R<sub>2</sub>= Replication 2, R<sub>3</sub>= Replication 3

#### IV. Conclusion

Considering the minimum requirement of the days of first flowering mean was (54.73), maximum number of leaves mean was (20.6) and maximum number of seeds mean was (1188.67), proved that BARI Surjamukhi 2 performed best than two other varieties. Above the result days of first flowering, number of leaves, number of seeds and head diameter of all the varieties BARI Surjamukhi 2 performed best. Kironi DS 1 produced second higher yield next to the variety Hy sun 33. After the study, it can be concluded that farmers can grow BARI Surjamukhi 2 in Noakhali region for better profit from the perspective of Bangladesh.

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