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EVALUATION OF MULCH PRACTICES ON GROWTH AND YIELD OF FOUR LISIANTHUS (*Eustoma grandiflorum*) GERMPLASM

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ABSTRACT

An experiment was conducted in the horticultural farm at Sher-e-Bangla Agricultural University, Dhaka to evaluate the Mulch practices on Growth and yield of four Lisianthus germplasm. The experiment consisted of four treatments (M_o: Control, M_s: Straw mulch, M_c: Cocodust mulch, M_{bp}: Black polythene mulch) and four Lisianthus germplasms (V_1: Arena Type Pure White, V_2: Double Pure White, V_3: Arena Type Light Pink, V_4: Super Magic Type Blue), laid out in a Randomized Complete Block Design (RCBD) with three replications. The results showed significant variations among the four varieties and different mulches. The tallest plant (71.6 cm), thickest stem (5.7 mm) and the largest flower size (70.6 mm) were found in V4 (Super magic type Blue) than others. Plants grown in Black polythene mulch (M_{bp}) recorded the tallest plant (65.1 cm), highest stem dia. (5.7 mm), maximum stem number (6.4), maximum number of flowers/plant (44.7) and the largest flower size (64.9 mm) than control. Based on the above parameters, the mulches are put in order as follows $M_{bp} \geq M_c \geq M_s \geq M_o$. These findings may provide useful data for the improvement of sustainable flower production of Lisianthus.

Keywords: Flower production, Petal coloration, Lisianthus germplasm, Mulch.

INTRODUCTION

Mulch is a technical word for 'soil covering.' Mulches are used in agriculture to save water and prevent erosion. It helps retain soil moisture, controls temperature variations, enhances the soil's physical, chemical, and biological characteristics, and provides nutrients, enhancing crop development and productivity (Dilip Kumar et al., 1990). In the winter, straw mulch increased 2-3°C soil temperature (Sarolia and Bhardwaj,

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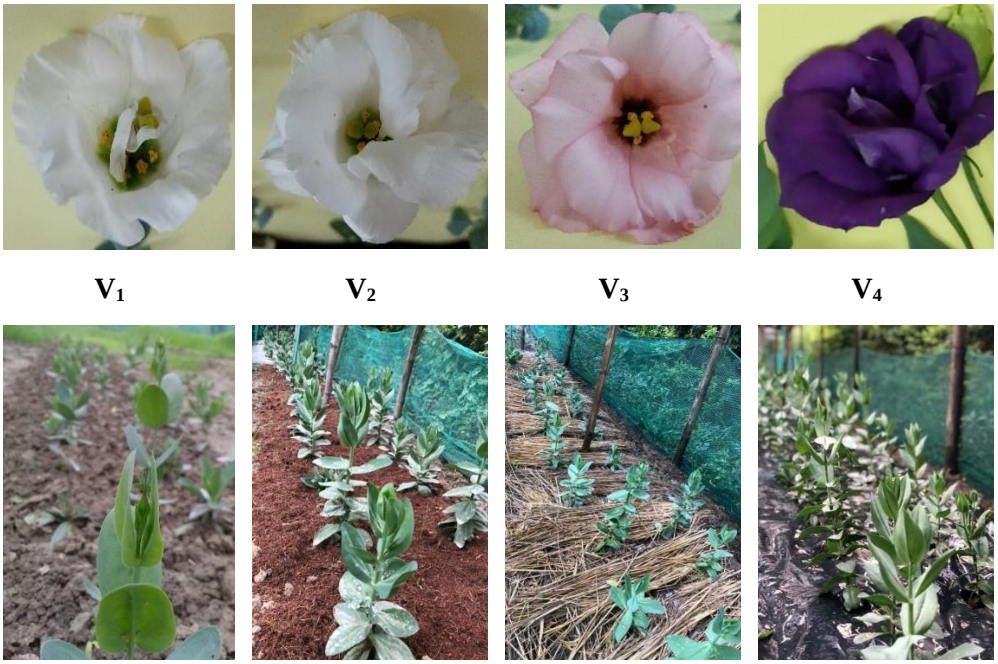
2012). Lamont (1993) stated that the soil beneath transparent mulch may be 7 degrees Celsius warmer than bare soil. Park et al. (1996) reported a 2.4^0C rise in 15 cm deep soil temperature with clear film and a 0.8^0C rise with black film. Kabir et al. (2007) found that mulch treatments affected dianthus flower output and petal coloration. Black polythene mulch improved moisture management, soil temperature and promote early flowering. Higher moisture, optimal nutritional availability, and other variables led to more vibrantly colored flowers under the mulch treatment. According to Bhuiyan et al. (2010), Mulching potted gerberas improved flower production, yield parameters, and petal coloration. Granberry et al. (1994) reported that, mulches reduce soil evaporation. It improves soil agrophysical properties by raising soil temperature and microbial activity. Consequently, it appears that mulching impacts the growth and quality of flowers, so we carried this research with Lisianthus germplasms. Lisianthus (*Eustoma grandiflorum*) is a beautiful annual or biennial cut flower (Roh and Lawson, 1988). The plant reaches a height of 15 to 60 centimeters and has bluish green, slightly succulent leaves and produce attractive funnel-shaped flowers on long, straight stems with vast charming color shades. Arena Type Pure White is single-flowered plants feature big, spherical petals where, Arena Type Double Pure White, Arena Type Light Pink and Super Magic Type Blue varieties have rose-like double blooms. Furthermore, the flowers have a shelf life of 12 to 25 days after harvest (Uddin et al., 2013). However, research on mulching for Lisianthus flower production is limited, so this study was conducted to determine the influence of black plastic mulch along with other traditional mulches on quality flower production of Lisianthus.

MATERIALS AND METHODS

The experiment was conducted at the horticulture farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh from January to March, 2019. The experimental plot was under the Agro Ecological Zone of Modhupur tract (AEZ No 28). The optimal temperature range was between 15^0 and 25^0 degrees Celsius with sufficient sunlight and the land topography was medium high and soil texture was silt clay with pH 6.5.

This is a two-factor experiment with three replications using the RCBD factorial design. Different Lisianthus germplasm (V_1: Arena Type Pure White, V_2: Double Pure White, V_3: Arena Type Light Pink, V_4: Super Magic Type Blue) and different types of mulches (M_o: Control, M_s: Straw mulch, M_c: Cocodust mulch, M_{bp}: Black polythene mulch) were used in this study. Seeds of Lisianthus were collected from Takii Seed, Japan. Seeds were seeded in plug trays (128-hole) filled with vermicompost and placed in the Nandini plant factory, which serves as the germination and growth chamber for the seedlings. Seed trays were kept in the Plant factory where optimum temperature was 20^0 Celsius and 16 hours of light was ensured (Sultana, M.N. et al., 2021). Daily care was provided for healthy seedling development.



V_1 **V_2** **V_3** **V_4**

M_o **M_c** **M_s** **M_{bp}**

Plate 1: Photographs showing, V_1: Arena Type Pure White, V_2: Double Pure White, V_3: Arena Type Light Pink, V_4: Super Magic Type Blue and M_o: Control, M_c: Cocodust, M_s: Straw mulch, M_{bp}: Black polythene mulch.

60-days-old seedlings were transplanted into the main field. Land was prepared through plowing and cross plowing, followed by laddering. In the experimental plots, the recommended amounts of manure and fertilizer were applied and mixed with the soil (Sultana, M.N. et al., 2022). There were 48-unit plots, each plot was 3 m × 1.5 m, and the gap between two blocks and two plots was kept at 0.5 m. The seedlings were planted at a consistent spacing of 30 cm × 25 cm (Husna, M.A. et al., 2022). Straw and cocodust mulches were placed after seedling transplanting, whereas a black polythene mulch was laid over the plot before seedling transplanting (Plate 2a.). After covering the plots with a black polythene sheet small holes were made (Plate 2b.) for seedling transplantation and preserving optimum plant-to-plant and row-to-row spacing. When necessary, intercultural techniques like as watering and drainage, weeding, gap filling, staking, disease and pest control were carried out. Data was collected on the basis of growth-related, yield attributing, and quality attributing parameters.

(a) **(b)** **(c)**

Plate 2: Experimental Photographs, (a) Black Polythene Mulch (b) hole in Black Polythene Mulch and (c) transplanting Seedling.

Petal color of Lisianthus was measured using a precision colorimeter iWAVE WF32 (Shenzhen Wave), followed by L* (lightness), a* and b* (two Cartesian coordinates) including C* and h_{ab} (Chroma and Hue angle), based on the CIELab scale (CIE, 1986 and McGuire, 1992).

The data collected for various parameters were statistically evaluated using Statistix-10 scientific analysis software to determine the significance of variance among treatments, and treatment averages were compared using the Least Significant Difference (LSD) test at 5% probability.

RESULTS AND DISCUSSION

Plant height: Significant variation was found with plant height among different cultivars of Lisianthus (Fig. 1). Average plant height varied from 49.6 to 71.6 cm. Among the four varieties the tallest plant (71.6 cm) was found in Super magic type Blue (V_4) and the smallest (49.6 cm) was in Arena Type Pure White (V_1). These results are closely related to Uddin et al. (2013), who said that the plant height of Lisianthus was varied among different germplasm of Lisianthus.

Plant height of Lisianthus varieties exposed statistically significant differences among different mulching treatments (Fig. 2). Maximum plant height (65.1 cm) was recorded at Black plastic mulch (M_{bp}) and the shortest plant (59.3 cm) was observed in control (M_0).

The interaction effect between mulching and Lisianthus varieties showed significant variation for Plant height (Table 3). Highest Lisianthus plant (75.2 cm) was recorded in Super magic type Blue varieties grown by using Black plastic mulch (V_4M_{bp}) and the lowest plant height (46.5 cm) was observed in Arena Type Pure White treated with no mulch (V_1M_o).

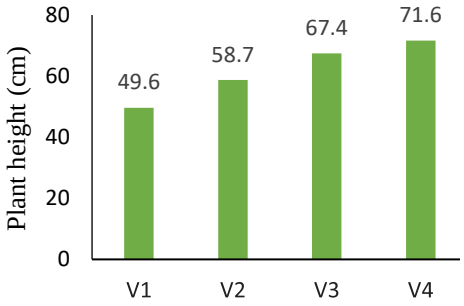


Figure 1. Performance of four varieties on the Plant height of Lisianthus. (Here, V_1: Arena Type Pure White, V_2: Double Pure White, V_3: Arena Type Light Pink, V_4: Super Magic Type Blue).

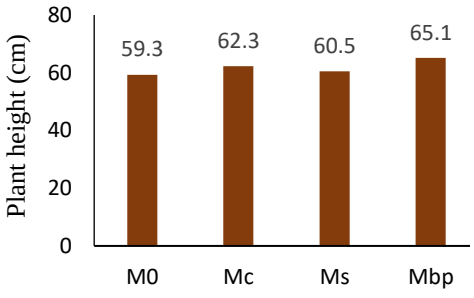


Figure 2. Effect of different mulching treatments on the Plant height of Lisianthus. (Here M_o: Control, M_c: Cocodust, M_s: Straw mulch, M_{bp}: Black polythene mulch).

Brunch number: Number of branches per plant varied significantly among the four Lisianthus cultivars (Table 1). The range of numbers was 6.9 to 5.3. V_3: Arena Type Light Pink had the highest number of brunches per plant (6.9), while V_2: Double Pure White yielded the fewest (5.3). Uddin et al. (2015) observed significant variation in the performance of eight germplasm of Lisianthus. The number of branches plays a crucial role in the overall production of plants, especially in the case of cut flowers, since a maximum number of stems corresponds to a maximum number of flowers.

The number of brunches per plant varied significantly depending on mulching treatments (Table 2). M_{bp} (Black polythene mulch treatment) yielded the greatest number of brunches per plant (6.4), whereas M_0 (control) yielded the fewest (5.7).

In the case of combined effect of Lisianthus cultivars and different types of mulching treatments, the number of brunches varied significantly (Table 3). The most stems were found in V_3M_{bp} (7.52), while the fewest were found in V_2M_o (5.2), and V_2M_s (5.2). These results were statistically similar.

Table 1. Evaluation of Lisianthus germplasm with different parameters

Germplasm	Brunch number	Stem diameter (mm)	Bud number/ plant	Flower number/ plant	Peduncle height (cm)	Flower head dia (mm)
V_1	5.9 b	4.4 d	13.2 c	35.3 b	10.0 b	47.1 d
V_2	5.3 d	5.5 b	11.9 d	29.2 c	8.3 c	61.3 c
V_3	6.9 a	5.0 c	19.1 a	44.1 a	10.2 b	67.0 b
V_4	5.7 c	5.7 a	16.6 b	36.6 b	10.9 a	70.6 a
LSD	0.1	0.1	0.5	1.9	0.5	0.7
CV%	1.1	2.2	2.96	4.8	4.3	0.9

Here, V_1: ArenaType Pure White, V_2: Double Pure White, V_3: ArenaType Light Pink, V_4: Super Magic Type Blue.

Table 2. Influence of Mulching Treatments with different parameters

Germplasm	Brunch number	Stem diameter (mm)	Bud number/ plant	Flower number/ plant	Peduncle height (cm)	Flower head dia (mm)
M_0	5.7 d	4.8 c	12.8 d	30.4 d	8.3 c	58.6 c
Mc	6.0 b	5.3 b	15.4 b	36.1 b	9.9 b	61.3 b
Ms	5.9 c	4.9 c	14.5 c	33.9 c	9.7 b	61.1 b
Mbp	6.4 a	5.7 a	17.9 a	44.8 a	11.6 a	64.9 a
LSD	0.1	0.1	0.5	1.9	0.5	0.7
CV%	1.1	2.2	2.9	4.8	4.3	0.9

[Here, Mo: Control, Mc: Cocodust, Ms: Straw mulch, Mbp: Black polythene mulch

Stem diameter: The measured stem diameter of the Lisianthus lines under study varied significantly (Table 1). V_4 (Super Magic Type Blue) displayed the thickest stem (5.7 mm), while V_1 (Arena Type Pure White) displayed the thinnest (4.4 mm). Both Harbaugh (2000) and Uddin et al. (2015) observed variation in Lisianthus stem diameter, claiming that stem diameter varies from variety to variety.

Mulching had a considerable effect on stem diameter (Table 2). The maximum stem diameter (5.7 mm) was found from M_{bp} treatment, whereas the smallest stem diameter (4.8 mm) was recorded in control, which is statistically equivalent to M_s (4.9 mm).

Significant variation in stem diameter was seen in the case of combined effects (Table 3). Among treatments, V_4M_{bp} had the highest proportion of stem diameters (6.5 mm), whereas V_1M_0 had the smallest (4.1 mm). Increasing photosynthetic efficiency improves plant vegetative growth.

Table 3. Combination effect of Mulching Treatments and performance of Lisianthus germplasm with different parameters

Treatments	Plant height (cm)		brunch number		Stem diameter (mm)		Bud number		Flower /Plant		Flower head diameter (mm)		Peduncle height (cm)	
V_1Mo	46.5	j	5.6	g	4.1	j	11.1	fgh	28.5	ghi	45.8	i	7.1	g
V_1Mc	50.1	i	6.1	e	4.4	ij	13.2	de	35.7	de	47.5	gh	9.9	cde
V_1Ms	48.5	i	5.9	f	4.2	j	12.4	ef	33.0	efg	46.3	hi	10.9	abc
V_1Mbp	53.1	h	6.4	d	4.7	hi	16.2	c	43.9	bc	49.0	g	12.2	a
V_2Mo	56.1	h	5.2	h	5.2	f	9.9	h	24.3	i	57.7	f	6.9	g
V_2Mc	59.1	f	5.5	g	5.7	cd	12.0	efg	30.4	fgh	60.3	e	8.7	ef
V_2Ms	57.3	fg	5.2	h	5.3	ef	10.9	gh	26.6	hi	61	e	7.8	fg
V_2Mbp	61.9	e	5.4	g	6.1	b	14.6	d	35.6	de	66.2	c	9.9	cde
V_3Mo	64.7	d	6.6	c	4.7	hi	16.3	c	38.8	cd	63.5	d	9.1	def
V_3Mc	68.3	c	6.9	b	5.1	fg	19.6	b	42.9	bc	67.5	c	9.9	cde
V_3Ms	66.2	d	6.7	bc	4.8	gh	18.4	b	40.3	bcd	66.2	c	9.3	cde
V_3Mbp	70.3	bc	7.5	a	5.6	de	21.8	a	54.4	a	70.8	b	11.9	a
V_4Mo	69.7	bc	5.4	g	5.2	f	13.9	d	30.2	fgh	67.9	c	10.2	bcd
V_4Mc	71.5	b	5.6	g	5.9	bc	16.7	c	35.4	def	69.9	b	11.3	ab
V_4Ms	70.0	bc	5.5	g	5.3	ef	16.3	c	35.7	de	70.7	b	10.2	bcd
V_4Mbp	75.2	a	6.2	de	6.5	a	19.4	b	45.1	b	73.9	a	12.2	a
LSD	1.9		0.2		0.4		1.37		5.2		1.89		1.3	
CV%	1.1		1.1		2.2		2.96		4.8		0.9		4.3	

Here, V_1: Arena Type Pure White, V_2: Double Pure White, V_3: Arena Type Light Pink, V_4: Super Magic Type Blue and M_o: Control, M_c: Cocodust, M_s: Straw mulch, M_{bp}: Black polythene mulch.

Bud Number: Bud numbers per plant varied significantly among the four types of Lisianthus germplasm (Table 1). The greatest number of buds was observed on V_3 (19.0), while V_2 had the fewest (11.9).

Different mulching techniques had a substantial effect on the quantity of bud studied (Table 2). The greatest number of buds (18.0) was seen in the M_{bp} treatment and the fewest in the M_0 treatment (12.81).

In the case of the combined effects of Lisianthus cultivars and mulching procedures, significant variance was seen (Table 3). The most buds (21.8) were found in V_3M_{bp}, while the fewest (11.1) were found in V_1M_0.

Flower number / plants: The number of flowers per plant varies across the four types of Lisianthus species (Table 1). V_3 (44.1) produced the most flowers per plant, whereas V_2 (28.3) produced the least (29.2). Ahmed (2017), Wazir (2014), Uddin et al. (2013) and Uddin et al. (2015) found the similar results in their examinations of numerous lines of Lisianthus. The total output of a plant is affected by the quantity of flower buds and flowers per plant.

Mulching treatments significantly affected flower yield per plant (Table 2). The M_{bp} treatment produced the highest number of flowers (44.8), whereas the M_0 treatment produced the fewest (30.4). This result is supported by the findings of Kabir et al. (2007) in Dianthus.

The combined influences showed significant variations in the number of flowers per plant (Table 3). V_3M_{bp} generated the highest number of flowers per plant (54.4) whereas V_2Mo produced the lowest number of flowers per plant (24.3).

Flower head diameter: Significant variation was observed with flower head diameter (Table 1) in four Lisianthus cultivars. V_4 has the biggest flower head diameter (70.6 mm), while V_1 had the smallest (47.1 mm). Harbaugh et al. (2015) observed similar variations in flower head diameter.

Mulching treatments significantly influenced flower head diameter (Table 2). The highest flower diameter (64.9 mm) was recorded at black plastic mulch (M_{bp}) and the minimum flower head diameter (58.6 mm) was found at the control condition (M_0).

In cases of combined effect, substantial variation in flower head diameter was noticed (Table 3). V_4M_{bp} had the largest flower head diameter (73.9 mm), followed by V_3M_{bp} (70.8 mm) and V_4M_s (70.7 mm), while V_1M_0 had the smallest (45.7 mm), followed by V_1M_s (46.3 mm) and V_1M_c (47.5 mm).

Peduncle length: The height of the peduncle varied significantly among the varieties studied. V_4 had the highest peduncle height (10.9 cm), while V_2 had the lowest (8.3 cm) (Table 1).

The peduncle height of Lisianthus changed over the experiment, revealing substantial differences (Table 2). The M_{bp} application had the longest peduncle length (11.6 cm), while the M_0 application had the shortest (8.3 cm).

In the case of the combined effect, significant variation was also seen (Table 3). The longest peduncle height (12.2 cm) was observed in V_4M_{bp}, while the smallest peduncle height (6.9 cm) was recorded in V_2M_0, which was statistically similar with V_1M_0 (7.1 cm).

Colorimetric measurement: Petal coloration of different varieties of Lisianthus differed significantly with traditional mulches (Table 4). Arena type Pure white (V_1) showed highest lightness (92.6) in Straw mulch, which was followed by Black plastic mulch (91.7) and lowest was recorded in control (87.9). In case of Arena type double white, highest lightness (91.5) observed in black plastic mulch and the lowest was recorded in coco dust mulching (89.5) (Table 4). Arena type Light Pink variety showed significant variation with different mulching practices. The maximum L* value (80.9) was found in control and minimum L* (74.9) was recorded in Black plastic mulch. The petal lightness (b*) also decreases in M_{bp} (11.3) which denotes the most darker color flower was found in M_{bp}. Super Magic Type Blue Plants under the black plastic mulch treatment produced most vivid blue color petal, because of lowest L value (27.8). Colorimetric assessments of four Lisianthus varieties were measured

By a Shenzhen Wave colorimeter (IWAVE WF32) where L* denotes lightness, a* and b* (two Cartesian coordinates), as well as C* and *hab* indicates Chroma and Hue angle, according to the CIELab scale with standard observer 100 and standard illumination D65 (CIE, 1986; McGuire, 1992). These results are closely related with Kabir et al. (2007). They also found the significant effect of mulching on flower production on Dianthus and black plastic mulch showed the most attractive color than other mulches.

Table 4. Petal color of four Lisianthus germplasm with different mulching practices

Variety	Treatments	Coloration				
		L*	a*	b*	C*	h_{ab}
Arena Type Pure White	Mo	87.9	-0.9	18.2	18.2	92.8
	Mc	88.3	-0.4	14.2	14.3	91.7
	Ms	92.6	-0.5	17.3	17.3	91.8
	Mbp	91.7	-0.4	16.1	16.1	91.6
Double White	Mo	90.6	-0.5	13.6	13.6	92.1
	Mc	89.5	-0.7	15.3	15.4	92.7
	Ms	90.7	-0.8	15.4	15.4	92.8
	Mbp	91.5	-0.6	16.3	16.2	92.2
Arena Type Light Pink	Mo	74.9	17.1	11.3	20.5	33.4
	Mc	80.9	10.7	13.8	17.5	52.3
	Ms	77.4	16.3	11.9	20.3	36.3
	Mbp	78.6	13.8	14.3	19.8	46.1
Super Magic Type Blue	Mo	38.3	27.6	-28.4	39.6	314.2
	Mc	27.9	35.8	-38.5	52.5	312.9
	Ms	31.7	34.8	-35.9	49.9	314.1
	Mbp	27.8	33.4	-33.4	47.2	314.9

Mo: control; Ms: Straw mulch; Mc: Cocodust mulch; and Mbp: Black plastic mulch; L*, lightness; C* (Chroma); $(a^{*2}+b^{*2})^{1/2}$ and h_{ab} (h°; hue angle), b*/a*; (a*, a hue of green to red; b*, blue to yellow)

CONCLUSION

Based on the results of the experiment, it can be stated that black plastic mulching produced the greatest outcomes for Lisianthus growth, yield, and quality-attributing parameters. And the best results were achieved by combining Black plastic mulch with Super magic type blue and Arena type light pink.

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