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EFFECTS OF IRRIGATION AND SOIL MULCHING IN DIFFERENT GROWING ENVIRONMENTS ON STRAWBERRY YIELD AND QUALITY

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ABSTRACT

A field experiment was conducted to assess the effects of irrigation and soil mulches on the growth, yield and quality of strawberries in different cultivation environments. There were eight treatments in a randomized complete block (RCB) design with three replications used in this experiment. Plants grown under white polyethylene grew taller and more spread out than those in the open field environment. The experimental soil was sandy loam and the field capacity was 29.6%. Relating growing environments, a significant difference was seen in strawberry yield under covered field shaded with white polyethylene and drip irrigation (410.50 g) than those in the open field with manual spray irrigation (337.26 g). The highest gross yield (10.00 t/ha) was observed in covered field (F_c) with alternate day drip irrigation. The total sugar and reducing sugar contents of the strawberries produced in the open field were 3.33% and 0.81%, respectively, for black polyethylene mulches with 2-days irrigation intervals, for the covered field they were 2.40% and 0.60%, respectively used in drip irrigation. The plants growing under covered field with drip irrigation has enhanced total anthocyanin but recorded the lowest vitamin C. The plants in the straw mulch plots used more water compared to those in the polyethylene mulch. The highest water use efficiencies were found using polyethylene mulch for both in the covered and open field environments with an irrigation intervals of 2-day.

Keywords: Growth, Yield, Quality, Drip irrigation, Soil mulches, Cultivation environments

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1. INTRODUCTION

Strawberries (*Fragaria×annanasa* Dutch.) are used in various foods. Strawberries contain vitamin C, carotene, dietary supplements, and other nutrients for human health. Day by day, it is becoming very popular and its cultivation has already expanded among farmers in different districts in Bangladesh (BSS, 2017). According to the Bangladesh Strawberry Association, Rajshahi district is the leader in strawberry cultivation compared to other districts (Firoz, 2018). Basically, all growing crops need irrigation. The strawberry is a moderately shallow-rooted plant and is subjected to water stress due to low irrigation. Water stress can impair photosynthetic movement and reduce the potential plant growth (El-Farhan and Pritts, 1997). Basically, a lack of soil moisture disrupts the growth, yield and survival of the strawberry plant during the dry season (Kruger *et al.,* 2000). Therefore, irrigation is the crucial role for the proper production of the strawberry (Taparaushiene and Miseckaite, 2014). The timing of irrigation is required at various stages of strawberry plants. The unavailability of water can ultimately affect all plant physiological processes that affect plant transience (Sarker *et al.,* 2005). There is also durable indication to suggest the opportunity that rainfall is declining from year to year due to global climate change (Kimura *et al.,* 2007). However, it is high time to progress efficient irrigation management practices that can reduce water consumption or exploit water use efficiency. The increasing global water scarcity has led irrigation planning to accomplish an ideal water supply for production (Boamah *et al.,* 2011). In this respect, the drip irrigation method has proven to be superior to other conventional irrigation systems (Bhella, 1988; Malik *et al.,* 1994).

Mulching techniques has a vital role in regulating soil temperature, conserving moisture, reducing evaporative losses, and deducing weed growth, thereby reducing the number of diseases affecting berries (Khadas, 2014 and Sharma, 2002), improving nutrient uptake as well water use efficiency and yield (Kumar and Dey, 2011). On the other hand, the mulching technique increases vegetative growth, crop yield and quality of strawberries (Angarej and Gaur, 2007); increases total water uptake and reduces surface runoff (Singh and Yadav, 2017) and increases fruit number and fruit size (Pandey et al., 2015). In recent years, plastic mulches have also been used for crop production and organic mulches support the diversity of beneficial soil macro invertebrates in the soil (Singh and Yadav, 2017); also, reduce disease levels in the fields (Coelho *et al.,* 2008). In contrast, black plastic mulch is used to warm the soil early (Singh and Kamal, 2012); also demonstrated significant superiority in reducing weed populations over other mulching treatments (Bakshi *et al.,* 2014). For strawberry cultivation, sheltered cultivation has been used to defend plants from extreme weather conditions and to better control diseases (Andriolo *et al.,* 2002 and Fernandes-Jr. *et al.,* 2002). Despite these studies mentioned above, most of the previous research has focused on traditional irrigation methods and mulching practices, and some of it has examined plastic mulch with irrigation methods other than drip

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irrigation using a combination of black polyethylene and straw mulch to produce strawberries grown in various growing settings. Therefore, the research was conducted to examine the response of strawberry growth, yield and quality to the effects of irrigation levels, soil mulches and different growing environments.

2. MATERIALS AND METHODS

2.1 Experimental site and collection of plants

The experiment was carried out in the month of November 2020 to March 2021 at the Agricultural Field Research Center of the Bangladesh Open University campus in Gazipur. The topography of the test field was uniform and level. A detailed soil analysis was performed to determine the basic properties of the soil prior to starting the experiment, as shown in Table 1.

Table 1: Basic physicochemical properties of the soil in the experimental field

Texture (%)	Field capacity (%)	Ca	Mg	K	Total N (%)	P	Cu
		meq/100ml				ppm	
Sandy loam	29.6	5.22	1.49	0.92	0.12	26.0	3.04

Source: Soil Science Laboratory, BARI

The strawberry (*Fragaria×annanasa* Dutch.) seedlings were collected from Rajshahi by Krishi Upakaran Nursery, Sher-e-Bangla Nagor, Dhaka and the strawberry was grown in two rows in the bed and each plot was 2 m×1 m with 20 seedlings with plant spacing was 0.50 m × 0.50 m.

2.2 Experimental design and field layout

The unit plot size and the spacing were 2.0 m×1.0 m and 50 cm×50 cm, respectively. Two levels of irrigation viz. alternate days (I_1) and 2-day intervals (I_2); two mulches viz. black polyethylene mulch (M_1) and straw mulch (M_2), and two environmental conditions were considered in this research as a covered field (white polyethylene shade) protected on all sides with an anti-bird garden netting (F_c) and an open field protected on all sides with a net (F_o). Another variable considered in this experiment, which was the irrigation methods (drip irrigation used at covered field and manual spraying applied in open field) but attempts have been made to keep the amount almost the same. There were eight treatments and the first four in a covered field (white polyethylene shade) protected on all sides by anti-bird garden netting (F_c) with drip irrigation (T_1= I_1× M_1; T_2= I_2× M_2; T_3 = I_1× M_2 andT_4 = I_2× M_1) and the last four were in an open field protected on top and all sides with anti-bird garden netting (F_o) with manual irrigation spraying by hand (T_5= I_1× M_1; T_6= I_2× M_2; T_7 = I_1× M_2 and T_8 = I_2× M_1). The experiment was set up in a randomized complete block design (RCBD) with three replicates.

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2.3 Procedure of field management

The plants were irrigation immediately after transplanting. Furthermore, until the seedlings were established, irrigation was carried out twice with an interval of 1-2 days. Thereafter, irrigation was applied according to the treatment (alternating day and 2-day intervals) by drip and spraying methods from the reserved water tank. The recommended fertilizer doses (N_{100}, P_{100}, K_{80} kg/ha) were used for all treatments by Biswas *et al.*, 2015. The total amount of P in the form of Triple Super Phosphate (TSP) was applied at the time of final tillage, while N and K in the form of urea and potassium salt (Muriate of Potash) were irrigated in four equal portions 15 days apart during the growing season applied.

The fertilizers were applied through split doses starting from 15 days after transplanting. The 25-day-old strawberry seedlings were transplanted on November 27, 2020 in unit plots of 2 m × 1 m with a distance of 50 cm × 50 cm. For mulching, 10 µm black polyethylene sheet having holes of 50 mm diameter at a distance of 50 cm × 50 cm was spread over the beds and strawberry seedlings were transplanted into the holes. After 7 days of transplanting, grass straw at 10 t/ha was used for straw mulch. For the irrigation application, water tanks with drip irrigation and a manual spray system were installed at a height of 1 m above the ground surface to irrigate 24 plots by gravity flow. The ripened strawberry was harvested from 15 February 2021 to 29 March 2021.

2.4 Weather data during strawberry cultivation

The average monthly weather data were collected from both the experimental field and Gazipur weather station to investigate the influence of temperature, duration of sunshine and rainfall in the growing season (Table 2), which affected strawberry cultivation in different irrigation management, culture and cultivation practices. During the growing season, the maximum temperature in March and the minimum in January were observed both in the open and covered field. On the other hand, the maximum hour of sunshine and rainfall were recorded in February and March, respectively.

Table 2: Average monthly weather data during experimental season

Month	Open field (F_o) temperature (^{0}C)		Covered field (F_c) temperature (^{0}C)		Sunshine hours	Rainfall (mm)
	Min.	Max.	Min.	Max.		
December, 2020	14.04	25.32	14.45	26.10	5.80	0
January, 2021	13.34	25.09	14.08	25.96	5.93	2.13
February, 2021	14.67	29.07	15.09	30.10	7.80	0.23

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March, 2021	20.84	33.87	21.68	34.39	7.48	3.04

2.5 Growth data of strawberry

The growth data of plant height, number of leaves, plant spread, days to 50% flowering and days of the first harvest were collected for the field and evaluated for further investigation according to the experimental design.

2.6 Yield data of strawberry

The yield data of number of fruits per plant, fruit length, fruit diameter, individual fruit weight, yield per plant, and gross yield (t/ha) were recorded from the experimental field in terms of treatments.

2.7 Quality parameters of strawberry

The various quality parameters of the harvested strawberries were analyzed in the Postharvest Technology Division, Bangladesh Agricultural Research Institute, Gazipur. According to the AOAC method (1995), the ascorbic acid of collected strawberries was calculated using the following formula and detailed have been described by Pervin *et al.* (2018).

$$\text{Ascorbic acid } (\text{mg}/100\text{g}) = \frac{\text{Titre} \times \text{Dye factor} \times \text{Vol. made up}}{\text{Aliquot of extract taken} \times \text{Weight of sample taken}} \times 100$$

The titratable acidity was measured by the method of Ranganna (1986) and by Pervin *et al.* (2021a & 2021b). Total soluble solids (TSS) results were expressed as % Brix (Cheour *et al.*, 1991) and detailed by Pervin *et al.* (2017). Total sugar and reducing sugar were also determined by Nelson (1944) and an explanation can be found in Pervin *et al.* (2021). In another term, total anthocyanin was determined by the method published by Burgos *et al.* (2013) and the results were expressed in mg/100 g dry weight.

2.8 Water requirement and water use efficiency

The initial soil moisture was measured using the gravimetric method. The soil moisture before each irrigation and at the time of harvest was determined by the same method. Irrigation water was applied to bring the soil moisture up to field capacity taking into account the effective root zone depth. Irrigation treatments began after the plant establishment. Each plot was irrigation with drip irrigation for the treatments of T_1 to T_4 and at the same time the manual spray irrigation method was applied for other treatments from T_5 to T_8 through the pipeline based on the calculated irrigation water. The irrigation water was calculated by the equation of Michael

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(1978) and by Pervin *et al.* (2014). Seasonal water requirement was calculated using the water balance equation as follows:

Seasonal water requirement (mm) = total irrigation water applied (mm) + seasonal effective rainfall (mm) + soil water contribution (mm).

In the experimental field, irrigation water was applied 53 times to the plot where the interval was an alternate day. On the other hand, the irrigation interval was 2 days, in which case 35 times irrigation were required. The water use efficiency (WUE) is the yield that can be produced from a given quantity of water. It was worked out by using the following formula and expressed as kg/ha-mm.

$$\text{WUE} = \frac{\text{Yield of strawbery } \left(\frac{\text{kg}}{\text{ha}}\right)}{\text{Total water used (mm)}}$$

2.9 Statistical analysis

The research was conducted using a Randomized Complete Block Design (CRD) for all treatments with three replications. The analysis was performed using the R-3.6.2 statistical software of, to determine ANOVA to equate mean value and significance levels of the data.

3. RESULTS AND DISCUSSION

3.1 Effect of irrigation and mulches on growth components of strawberry at different cultivation environment with various methods of irrigation

The effect of irrigation and mulches on growth components of strawberry at different growing environments with various methods of irrigation are shown in Table 3. The plant height (cm), number of leaves/plant, plant spread (E-W and N-S) (cm), day to 50% flowering and days of 1st fruiting were significantly influenced by different irrigation (methods and levels), mulching and growing environments. The crop grown in covered field white polyethylene shaded with drip irrigation and black polyethylene mulch recorded maximum plant height (19.20 cm and 17.80 cm), whereas the minimum plant height (16.80 cm and 15.60 cm) recorded due to open field. The maximum plant spread (E-W: 32.70 cm and 31.80 cm; N-S: 31.90 cm and 30.80 cm) was recorded in the plants grown in covered field white polyethylene shaded with drip irrigation and black polyethylene mulch, whereas minimum plant spread was observed in an open field. The present findings are in accordance with those as reported by Pires *et al.* (2006); it may be attributed to favorable environment and better moisture conservation vis-a-vis suppression of weeds resulted in better plant growth parameters (Qureshi *et al.*, 2012). The plants grown under open field has the highest number of leaves (14.6 and 13.5) per plant due to better exploration of

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nutrients and water (Sturm *et al.*, 2003) and once it is grown under covered field, the number of leaves/plant reduced to 13.3. The days to 50% flowering and days of 1st harvest were observed little bit early in an open field (F_0) with manual irrigation spraying by hand compared to cover field this might be happened to the direct expose to the sunlight.

Table 3: Effect of irrigation and mulching on plant growth of strawberry at different cultivation environment with various methods of irrigation

Treatments	Plant height (cm)	No. of leaves/plant	Spread (cm)		Days to 50% flowering	Days of 1st harvest
			E-W	N-S		
Covered field (F_c) with drip irrigation						
T_1= I_1×M_1	19.2a	13.3a	32.7a	31.9a	63d	92a
T_2= I_2× M_2	15.7d	11.6d	28.8d	28.6d	67a	87d
T_3 = I_1× M_2	16.8c	12.0c	29.5c	29.3c	66b	90b
T_4 = I_2× M_1	17.8b	12.5b	31.8b	30.8b	65c	88c
CV%	2.06	3.78	1.28	0.88	1.04	1.12
LSD	0.06**	0.99*	1.56**	1.14**	0.69**	0.82**
Open field (F_0) with manual irrigation spraying by hand						
T_5= I_1× M_1	16.8a	14.6a	30.4a	31.3a	58d	87a
T_6= I_2× M_2	14.9c	13.2c	27.6d	28.1c	64a	84c
T_7 = I_1×M_2	15.4b	13.8b	28.7c	27.5d	62b	86b
T_8 = I_2× M_1	15.6b	13.5bc	29.8b	30.2b	60c	83d
CV%	2.04	3.98	1.18	0.89	1.08	1.17
LSD	0.05**	0.95*	1.44**	1.19**	0.58**	0.79**

All means followed by different letters relating to same parameter are statistically different at the 5% level using the LSD. * = 5% Level of significance; ** = 1% Level of significance

3.2 Effect of irrigation and mulches on yield and yield contributing characters of strawberry at different cultivation environment with various methods of irrigation

In Table 4 represents that the number of fruits per plant, individual fruit weight (g), fruit length (mm), fruit diameter (mm), yield per plant (g) and gross yield (t/ha) were significantly influenced by irrigation, mulches and growing environments. It was evident from the data that the number of fruit per plant (18.45 and 17.63), individual fruit weight (22.25 g and 21.42 g), fruit length (37.50 mm and 35.85 mm), fruit diameter (28.50 mm and 26.75 mm) were recorded the maximum in plants grown under covered field conditions than open field growing environment conditions. There was a significant difference in term of yield between the growing environments. The significantly higher yield recorded in the plants grown under covered field

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shaded with white polyethylene using drip irrigation condition over the plants grown in the open field was associated with the production of higher number of fruits and fruit yield (410.50 g and 377.63 g per plant) than those in open field and the direct sunlight in day might have reduced strawberry flower formation and fruit quality in open field conditions. Enhanced fruiting, i.e. fruit yield increased by 27% and advanced flowering by two weeks through using plastic tunnels in northern India were investigated by Singh et al. (2009). Finally, the highest gross yield (10.00 t/ha) was observed in covered field (F_c) with alternate day drip irrigation than those of an open field and it was 8.22 t/ha in same amount irrigation spray with hand as well mulching with black polyethylene. The black polyethylene mulch performed identically to the straw mulch at all irrigation levels, a study consistent with Shrivastava *et al.* (1994) and Tiwari *et al.* (1998).

Table 4: Effect of irrigation and mulching on yield and yield contributing characters of strawberry at different cultivation environment with various methods of irrigation

Treatments	No. of fruits/plant	Individual fruit wt. (g)	Fruit length (mm)	Fruit diameter (mm)	Yield/plant (g)	Gross yield (t/ha)
Covered field (F_c) with drip irrigation						
T_1= I_1×M_1	18.45	22.25	37.50	28.50	410.50	10.00
T_2= I_2× M_2	15.87	18.54	31.18	24.85	294.23	7.17
T_3 = I_1× M_2	16.32	20.83	33.25	25.92	339.95	8.29
T_4 = I_2× M_1	17.63	21.42	35.85	26.75	377.63	9.21
CV%	1.29	0.69	3.48	3.07	1.04	1.18
LSD	0.69**	0.86**	1.36**	1.24**	0.69**	1.86**
Open field (F_0) with manual irrigation spraying by hand						
T_5= I_1× M_1	17.34	19.45	34.56	25.54	337.26	8.22
T_6= I_2× M_2	15.12	16.34	28.72	20.34	247.06	6.02
T_7 = I_1×M_2	15.74	17.65	30.25	21.75	275.45	6.72
T_8 = I_2× M_1	16.25	18.72	32.78	23.81	304.20	7.42
CV%	1.10	0.67	3.23	3.16	1.08	1.23
LSD	0.63**	0.96**	1.34**	1.29**	0.58**	1.79**

All means followed by different letters relating to same parameter are statistically different at the 5% level using the LSD. * = 5% Level of significance; ** = 1% Level of significance

3.3 Effect of irrigation and mulches on quality parameters of strawberry at different cultivation environment with various methods of irrigation

The effect of irrigation and mulches on quality parameters of strawberry at different growing environments with various methods of irrigation are shown in Table 5. There was no significant

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effect of growing environment on fruit TSS and acidity of strawberry fruits. The total sugars (2.95% and 3.33%) and reducing sugars (0.76% and 0.81%) contents of strawberry fruits produced in the open field condition had higher than the fruits produced in the covered field with protected environment. It might be due to the greater light intensity and greater plant photosynthetic activity in the plant cultivation environment suggested by Beckmann *et al.* (2006). Significantly high ascorbic acid/vitamin C was found in open field (88.20 mg/100 g and 77.55 mg/100 g) than the fruits grown in covered field (83.05 mg/100 g and 74.80 mg/100 g). This could be strongly influenced by environmental cultivation conditions, with light intensity thus affecting the content of ascorbic acid in strawberry fruits (Venter, 1977 and Sonkar *et al.*, 2012). The plants growing under covered field with drip irrigation has enhanced total anthocyanin content (238.17 mg/100 g for 2-day intervals) but recorded lowest content of vitamin C. The covered field might help in anthocyanin accumulation in the ripening fruits though partial shade may have increase phenylalanine ammonia lyase (PAL) and UDPGFT (Uridine-diphosphate-glucose- flavonoid-3-o transferee) regulatory enzyme activities (Cheng and Breen, 1991).

Table 5: Effect of irrigation and mulching on quality parameters of strawberry at different cultivation environment with various methods of irrigation

Treatments	TSS (^{0}B)	Titrable acidity (%)	Total sugar (%)	Reducing sugar (%)	Vitamin C (mg/100g)	Total anthocyanin (mg/100g)
Covered field (F_c) with drip irrigation						
T_1= I_1×M_1	4.07	1.17	1.97c	0.40c	83.05a	164.42d
T_2= I_2× M_2	5.02	1.14	2.88a	0.71a	72.83d	198.03b
T_3 = I_1× M_2	5.00	1.16	2.39b	0.59b	79.46b	186.27c
T_4 = I_2× M_1	5.04	1.13	2.40b	0.60b	74.80c	238.17a
CV%	NS	NS	1.05	0.95	3.04	4.18
LSD	0.80	0.30	1.29**	1.10**	1.38**	1.66**
Open field (F_0) with manual irrigation spraying by hand						
T_5= I_1× M_1	5.00	1.28	2.95c	0.76b	88.20a	158.07d
T_6= I_2× M_2	6.08	1.26	3.38a	0.83a	72.97d	196.39b
T_7 = I_1×M_2	6.07	1.29	2.90d	0.72c	79.77b	184.98c
T_8 = I_2× M_1	6.12	1.15	3.33b	0.81a	77.55c	218.08a
CV%	NS	NS	1.17	0.89	3.18	4.23
LSD	0.69	0.25	1.23**	1.12**	1.58**	1.59**

All means followed by different letters relating to same parameter are statistically different at the 5% level using the LSD. Ns- Non-significant, * = 5% Level of significance; ** = 1% Level of significance

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3.4 Water requirement and water use efficiency for strawberry cultivation

There were significant differences in seasonal water requirement and water use efficiency by the strawberry resulting from the application of different drip and manual irrigation, mulches and cultivation environments as depicted in Table 6. When irrigation applied in an alternate day and 2-day intervals, the plants in the straw mulch plots used more water compared to those in the polyethylene mulched plots which consumed 482.1 mm and 481.2 mm per season for covered field and 481.5 mm and 480.8 mm per season for open field, respectively. This might be happened due to the presence and type of mulching with rate of evaporation from soil (Tindall *et al.*, 1991). The highest water use efficiencies were found 28.43 kg/ha-mm and 22.95 kg/ha-mm using polyethylene mulch for both cover field and open field, respectively with 2-day irrigation intervals.

Table 6: Irrigation frequency, water requirement and water use efficiency for strawberry cultivation during growing season as influenced by different drip and manual irrigation, mulches and cultivation environments

Treatments	Irrigation events (Number)	Irrigation water applied (mm)	Effective rainfall (mm)	Soil moisture contribution (mm)	Seasonal water requirement (mm)	Water use efficiency (WUE) (kg/ha-mm)
Covered field (F_c) with drip irrigation						
$T_1 = I_1 \times M_1$	53	465a	5.4	10.8	481.2a	20.74c
$T_2 = I_2 \times M_2$	35	307b	5.4	11.5	323.9b	22.21b
$T_3 = I_1 \times M_2$	53	465a	5.4	11.7	482.1a	17.23d
$T_4 = I_2 \times M_1$	35	307b	5.4	10.5	322.9b	28.43a
CV%	-	1.08	-	-	1.17	2.98
LSD	-	10.20**	-	-	11.12**	8.80*
Open field (F_0) with manual irrigation spray by hand						
$T_5 = I_1 \times M_1$	53	465a	5.4	10.4	480.8a	17.07c
$T_6 = I_2 \times M_2$	35	307b	5.4	10.9	323.3b	18.66b
$T_7 = I_1 \times M_2$	53	465a	5.4	11.1	481.5a	13.98d
$T_8 = I_2 \times M_1$	35	307b	5.4	10.2	322.6b	22.95a
CV%	-	1.09	-	-	1.10	2.78
LSD	-	10.60**	-	-	11.32**	8.60*

All means followed by different letters relating to same parameter are statistically different at the 5.0% level using the LSD. *= 5% Level of significance; ** = 1% Level of significance

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For covered field with drip irrigation, the maximum water use efficiency was measured at 2-day interval with the use of black polythene mulch (24.43 kg/ha-mm) followed by the grass straw (22.21 kg/ha-mm), while the lowest WUE (17.23 kg/ha-mm) was recorded in the alternate day irrigation with straw mulch condition. On the other hand, for open field with manual spray by hand; the maximum water use efficiency was measured at 2-day interval with the use of black polythene mulch (22.95 kg/ha-mm) followed by the grass straw (18.66 kg/ha-mm), while the lowest WUE (13.98 kg/ha-mm) was recorded in the alternate day irrigation with straw mulch condition. This findings agreed with Berihun (2011) for tomato cultivation. The highest water use efficiency was seen with the use of black polyethylene mulch (Islam, 2022), while the lowest values were observed with the use of grass straw (Pervin *et al.*, 2014), but the differences between treatments were significant; the similar investigation was reported by Biswas *et al.* (2015). In another way, the use of black polyethylene mulch resulted in higher WUE than organic mulch due to the efficient weed control along with the efficient use of water and nutrients (Mukherjee *et al.*, 2012 and Dunage *et al.*, 2009).

4. CONCLUSION

From the present investigation and other reviewed work, it is evident that gross fruit yield and water use efficiency of strawberries can be significantly increased in a covered field environment using black polyethylene mulching and a drip irrigation system. The drip irrigation method with two line crop grown was superior to the conventional spray by hand irrigation method, in which water is applied to each plant in a specific row. Drip irrigation with cover shade and black polyethylene mulch is said to be suitable for strawberry production, the water use efficiency by the plants can be enhanced if the beds are mulched and the irrigation schedule is operated at an alternate day. In general, the yield and other physical parameters (fruit length, width, average fruit weight) of strawberry were higher in covered field with drip irrigation were higher than fruit grown in open field. Field-grown fruits were tastier due to the high total sugars and reducing sugars. Therefore, it can be concluded that an open field conditions are not suitable for growing strawberries to improve not only the yield but also the quality of the fruit. For the highest strawberry yield in Bangladesh; farmers would be helpful if they used a covered field with drip irrigation technology and black polyethylene mulch and an alternate day irrigation schedule in their fields.

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