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Influence of drip irrigation and plastic mulch on crop growth and yield of cucumber (*Cucumis sativus* L.)

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Abstract
The field experiments was carried out at the Zonal Agricultural and Horticultural Research Station (ZAHRS), Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, (KSNUAHS) Navile, Shivamogga during 2020-21 and 2021-22. The experiment, "Effect of drip irrigation and plastic mulch on crop growth, yield of cucumber (*Cucumis sativus* L.) under protected structure" had nine treatments comprising of three levels of irrigation (60, 80 and 100% crop ET) and three levels of mulching (white, black and without mulch) laid out in factorial random block design. The average crop yield was highest i.e., 110.70 t ha^{-1} under treatment consisting of 100% crop ET with white plastic mulch as compared to black mulch and without mulch.

Keywords: Leaf area index, evapotranspiration, plastic mulch, drip irrigation and cucumber

Introduction
Cucumber (*Cucumis sativus* L.) is one of the popular vegetable crop grown broadly throughout the world (Soleimani *et al.*, 2009) [13]. In India, Andhra Pradesh, Karnataka, Telangana and Assam are leading cucumber producing states. India produces 1608000 Mt of cucumber during 2021-22 with an area of 1,16,000 ha. in which Karnataka contributes 1,30,360 tonnes by an area of 8,300 ha. In Karnataka, cucumber is produced everywhere, but large amount of cucumber is produced Northern Uttar Karnataka and adjoining areas. The cucumber growers are looking for innovative cultivation practices to harvest best quality cucumber fruits with higher yield and for early/off season cucumber production, and protected cultivation is an alternative for them.
Cucumber is a thermophilic and frost susceptible crop, growing best at a temperature above 20°C. Cucumber grows successfully under conditions of high light, high humidity, high soil moisture, temperature and fertilizers in green-houses (El-Aidy *et al.*, 2007) [4]. At present, cultivation of cucumber in open fields is a widespread practice in India. But, cucumber grown in open fields during spring, summer or rainy-autumn seasons is exposed to various abiotic (low temperature and unpredictable weather) and biotic (cut worms, leaf miner, thrips, mites and incidence of downy/powdery mildew) stress. Therefore, it is not possible to produce quality and disease-free cucumber in open condition when compared to the cucumber produced under protected environment. Therefore, for good quality cucumber it is important to take up its cultivation under protected conditions particularly, when production of cucumber is for export purpose.
India has abundant land resources but irrigation water is scarce for adequately exploiting the soil potentials. This calls for adoption of advanced irrigation methods such as drip irrigation which aims at effective use and management of the limited water resources. Irrigation is an important limiting factor for crop production, because it is associated with many factors of plant environment, which influence growth and development. Availability of adequate amount of moisture at critical stages of plant growth not only optimizes the metabolic process in plant cells but also increases the effectiveness of the mineral nutrients applied to the crop. Consequently any degree of water stress may produce deleterious effects on growth and yield of the crop (Saif

et al., 2003) [11].

Plastic mulches are commonly used to modify soil temperature, weed control, conserve water, protect fruits from contact with soil moisture and pathogens, repel certain insects, and control erosion (Schrader, 2000) [12]. White plastic mulches can be used to establish crops in the summer, when a reduced soil temperature might be beneficial. Coextruded white on black plastic mulch helps cool the soil while black controlling weeds. The soil temperature was found higher in infra red than red and in black than silver plastic mulch. Red and black mulch were provided an equal amount of soil temperature (Henry and Barbara. 2000) [5]. The temperatures registered in bare soil were always lower than under mulch treatments and the soil temperature under the different mulches was affected by the type of material employed. Use of mulch along with fertigation is beneficial for conserving moisture, reducing weed infestation and preventing leaching loss of nutrients. The present investigation is planned to determine the influence of irrigation and mulching on crop growth parameter and crop yield parameter of cucumber under protected structure.

Materials and Methods

The experiment was carried out on White and Black LDPE sheets of 40-micron thickness were used to cover the beds for mulching treatment. The experiment was carried out using Factorial random block design with the following levels.

Factor 1: Irrigation levels (I)

I_1: Drip irrigation at 60 percent of ET
I_2: Drip irrigation at 80 percent of ET
I_3: Drip irrigation at 100 percent of ET

Factor 2: Mulching levels (M)

M_1: Mulching with white polythene sheet
M_2: Mulching with black polythene sheet
M_3: Without mulching (Control)

In present study effect of drip irrigation and plastic mulch on crop growth parameter *viz*., vine length, stem girth, leaf area index and crop yield parameter

Growth Parameters: For periodical field observations, five plants were selected randomly from each treatment and were tagged. Observations such as vine length, stem girth and leaf area index at the time of last harvest were taken from selected five plants. The observations were taken at 15, 30, 45, 60, 90 DAS (days after sowing) and at harvest. The stem girth was measured using vernier calliperse at a height of 15 cm from base of the vine. Leaf area index was worked out using the following formula (Watson, 1952) [14].

$$LAI = \frac{\text{Leaf area } (cm^2 plant^{-1})}{\text{Ground area } (cm^2 plant^{-1})}$$

Crop yield parameters: Fruit weight was calculated by selecting fruit randomly from each treatment at harvest stage from five tagged plants and average was worked out and expressed in grams. Ten fruits from each randomly selected plant were measured using the standard centimeter scale from proximal end to distil end and the mean value was calculated and expressed in centimeters. The fruits harvested from the tagged plants were carefully weighed on an electronic balance until the final harvest and the cumulative of all the harvest was calculated and expressed as total yield kg $plant^{-1}$ and yield ha^{-1}.

Results and Discussion

Total amount of water applied under different drip irrigation levels based on different crop growth stages of both the seasons are presented in Table 1. For the first season, the highest water requirement (1577.22 l) was recorded during mid-season stage at 100 per cent crop ET, followed by crop development stage (948.63 l) and late stage (577.97 l). Lowest water requirement was found in 60 per cent crop ET (117.75 l) during initial stage. The water requirement at initial stage was higher at 100 per cent crop ET (196.25 l) followed by 80 per cent crop ET (157 l) and lowest water requirement found in 60 per cent crop ET (117.75 l). For the second season the highest water requirement was recorded during mid-season stage at 100 per cent crop ET (1910.60 l) and lowest water requirement was found in 60 per cent crop ET (138.74 l) of initial stage. The water requirement at initial stage was higher in 100 per cent crop ET (231.24 l) followed by 80 percent crop ET (184.99 l) and lowest water requirement was found in 60 per cent crop ET (138.74 l).

Table 1: Amount of water applied to cucumber at different crop growth stages in cucumber during 2020-21 and 2021-22

Crop growth stage	Water applied during June to September 2020 (l)			Crop growth stage	Water applied during June to September 2021 (l)		
	I_1 (60% ET)	I_2 (80% ET)	I_3 (100% ET)		I_1 (60% ET)	I_2 (80% ET)	I_3 (100% ET)
Initial (0-20 days)	117.75	157.00	196.25	Initial (0-20 days)	138.74	184.99	231.24
Development (20-50 days)	569.18	758.90	948.63	Development (20-50 days)	592.88	790.51	988.14
Mid-season (50-90 days)	946.33	1261.77	1577.22	Mid-season (50-90 days)	1146.36	1528.48	1910.60
Late -season (90-105days)	346.78	462.38	577.97	Late -season (90-105days)	370.68	494.24	617.80

Crop growth parameter: The vine length was higher (513.67 cm, 515.67 cm and 514.67 cm during 2020-21, 2021-22 and pooled data, respectively) in the interaction effect of drip irrigation at 100% crop ET with white polythene mulch at 45 DAS (Table 2). The vine length was lower (485 cm, 486 cm and 485.50 cm during 2020-21, 2021-22 and pooled data, respectively) under drip irrigation at 60% crop ET in un mulched condition.

Table 2: Effect of drip irrigation and plastic mulching on vine length in cucumber at different DAS

Treatment details	Vine length (cm)								
	30 DAS			45 DAS			60 DAS		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Irrigation treatments (I)									
I_1	196.40	197.53	196.97	487.78	488.22	488.00	499.67	500.45	500.06
I_2	228.97	229.59	229.28	499.89	500.22	500.06	510.89	511.11	511.00
I_3	295.69	296.78	296.23	511.78	512.00	511.89	520.89	522.67	521.78
S.Em. ±	3.63	3.32	3.46	0.44	0.81	0.52	0.60	0.85	0.65
CD @ 5%	10.86	9.95	10.36	1.32	2.44	1.56	1.79	2.54	1.94
Mulching treatments (M)									
M_1	256.86	257.50	257.18	501.45	503.00	502.22	513.78	514.45	514.11
M_2	246.98	257.50	247.47	501.33	503.00	501.22	512.33	514.45	512.83
M_3	217.22	257.50	217.83	496.67	503.00	496.50	505.33	514.45	505.89
S.Em. ±	3.63	3.32	3.46	0.44	0.81	0.52	0.60	0.85	0.65
CD @ 5%	10.86	9.95	10.36	1.32	2.44	1.56	1.79	2.54	1.94
Interaction effect (I×M)									
I_1M_1	220.40	222.33	221.37	489.67	491.33	490.50	503.00	504.00	503.50
I_1M_2	201.40	201.53	201.47	488.67	487.33	488.00	501.67	502.33	502.00
I_1M_3	167.40	168.73	168.07	485.00	486.00	485.50	494.33	495.00	494.67
I_2M_1	230.03	230.03	230.03	501.00	502.00	501.50	511.67	511.00	511.33
I_2M_2	234.33	235.53	234.93	501.67	503.00	502.33	512.33	513.00	512.67
I_2M_3	222.53	223.20	222.87	497.00	495.67	496.33	508.67	509.33	509.00
I_3M_1	320.13	320.13	320.13	513.67	515.67	514.67	526.67	528.33	527.50
I_3M_2	305.20	306.80	306.00	513.67	513.00	513.33	523.00	524.67	523.83
I_3M_3	261.73	263.40	262.57	508.00	507.33	507.67	513.00	515.00	514.00
S.Em. ±	6.28	5.76	6.00	0.76	1.41	0.90	1.04	1.47	1.12
CD @ 5%	18.81	17.23	17.95	NS	NS	NS	3.10	4.40	3.36

The data pertaining to stem girth at stem girth at different days after sowing is presented in Table 3. In the interaction effect was noticed that the stem girth was maximum in treatment consisting of drip irrigation at 100% crop ET and white polythene mulch at 30 DAS i.e., 6.60, 6.77 and 6.68 during 2020-21, 2021-22 and pooled data, respectively. The stem girth was minimum in treatment consisting of drip irrigation at 60% crop ET and un mulched condition at 30 DAS i.e., 4.40, 4.30 and 4.35 during 2020-21, 2021-22 and pooled data, respectively. The maximum stem girth due to irrigation and mulching may be due to increase in growth parameters which minimized evaporation loss and extended retention of moisture. Similar results have been reported by Parmar, *et al*. (2013) [9], Dean ban *et al*. (2004) [2].

Table 3: Effect of drip irrigation and plastic mulching on stem girth in cucumber at different DAS

Treatment details	Stem girth (cm)								
	30 DAS			45 DAS			60 DAS		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Irrigation treatments (I)									
I_1	4.72	4.89	4.81	6.51	6.39	6.45	7.76	7.68	7.72
I_2	5.56	5.66	5.61	7.32	7.16	7.24	8.31	8.19	8.25
I_3	6.32	6.36	6.34	8.14	8.07	8.11	9.37	9.33	9.35
S.Em. ±	0.03	0.10	0.06	0.03	0.08	0.05	0.03	0.08	0.05
CD @ 5%	0.10	0.30	0.17	0.08	0.24	0.14	0.09	0.22	0.14
Mulching treatments (M)									
M_1	5.78	6.77	5.88	7.59	7.47	7.53	8.59	8.63	8.61
M_2	5.62	6.43	5.69	7.37	7.27	7.32	8.52	8.42	8.47
M_3	5.20	5.87	5.18	7.02	6.88	6.95	8.32	8.14	8.23
S.Em. ±	0.03	0.10	0.06	0.03	0.08	0.05	0.03	0.08	0.05
CD @ 5%	0.10	0.30	0.17	0.08	0.24	0.14	0.09	0.22	0.14
Interaction effect (I×M)									
I_1M_1	4.97	5.30	5.13	6.87	6.77	6.82	7.87	7.90	7.88
I_1M_2	4.80	5.07	4.93	6.57	6.40	6.48	7.80	7.73	7.77
I_1M_3	4.40	4.30	4.35	6.10	6.00	6.05	7.60	7.40	7.50
I_2M_1	5.77	5.90	5.83	7.50	7.33	7.42	8.40	8.30	8.35
I_2M_2	5.70	5.77	5.73	7.33	7.23	7.28	8.37	8.23	8.30
I_2M_3	5.20	5.30	5.25	7.13	6.90	7.02	8.17	8.03	8.10
I_3M_1	6.60	6.77	6.68	8.40	8.30	8.35	9.50	9.70	9.60
I_3M_2	6.37	6.43	6.40	8.20	8.17	8.18	9.40	9.30	9.35
I_3M_3	6.00	5.87	5.93	7.83	7.73	7.78	9.20	9.00	9.10
S.Em. ±	0.06	0.18	0.10	0.05	0.14	0.08	0.05	0.13	0.08
CD @ 5%	NS	NS	NS	0.14	NS	NS	NS	NS	NS
S.Em. ±	0.53	0.96	0.64	0.68	1.02	0.55	0.69	1.03	0.52
CD @ 5%	NS	NS	NS	2.02	3.05	1.65	NS	NS	NS

The leaf area index was maximum (1.37, 1.38 and 1.38 during 2020-21, 2021-22 and pooled data, respectively) in the interaction of (I x M) i.e., drip irrigation at 100% crop ET and white polythene mulch at 60 DAS. The leaf area index was minimum (1.29, 1.28 and 1.29 during 2020-21, 2021-22 and pooled data, respectively) in the interaction of (I x M) i.e., drip irrigation at 60% crop ET and un mulched condition at 60 DAS (Table 4). The increased leaf area index in polyhouse could be due to less light intensity in polyhouse which resulted in production of large sized leaves. Rajasekar *et al.*(2013) [10] and Parashar *et al.* (2016) [15] in cucumber. These findings are similar to Dillip K. D., *et al.* (2018) [3] who reported maximum leaf area index under poly house conditions in cucumber. This might be due to the good interception of light to the entire plant canopy in widely spaced plants and less competition among the plants for the available resources because of less plant density.

Table 4: Effect of drip irrigation and plastic mulching on leaf area index in cucumber at different DAS

Treatment details	Leaf area index								
	30 DAS			45 DAS			60 DAS		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Irrigation treatments (I)									
I_1	1.15	1.16	1.16	1.23	1.25	1.24	1.30	1.32	1.31
I_2	1.18	1.20	1.19	1.28	1.30	1.29	1.33	1.34	1.34
I_3	1.21	1.24	1.23	1.32	1.35	1.34	1.36	1.38	1.37
S.Em. ±	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD @ 5%	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Mulching treatments (M)									
M_1	1.19	1.20	1.20	1.29	1.31	1.30	1.34	1.36	1.35
M_2	1.18	1.19	1.19	1.28	1.29	1.29	1.33	1.34	1.34
M_3	1.17	1.16	1.17	1.26	1.25	1.26	1.32	1.31	1.32
S.Em. ±	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD @ 5%	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Interaction effect (I×M)									
I_1M_1	1.16	1.18	1.17	1.24	1.25	1.25	1.32	1.31	1.32
I_1M_2	1.15	1.16	1.16	1.23	1.24	1.24	1.31	1.30	1.31
I_1M_3	1.14	1.15	1.15	1.22	1.23	1.23	1.29	1.28	1.29
I_2M_1	1.19	1.20	1.20	1.30	1.31	1.31	1.34	1.35	1.35
I_2M_2	1.18	1.19	1.19	1.28	1.29	1.29	1.33	1.34	1.34
I_2M_3	1.17	1.18	1.18	1.25	1.26	1.26	1.32	1.31	1.32
I_3M_1	1.22	1.23	1.23	1.34	1.36	1.35	1.37	1.38	1.38
I_3M_2	1.21	1.22	1.22	1.33	1.34	1.34	1.37	1.39	1.38
I_3M_3	1.20	1.19	1.20	1.30	1.31	1.31	1.35	1.36	1.36
S.Em. ±	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD @ 5%	NS	NS	NS	0.01	0.01	0.01	NS	NS	NS

In the interaction effect (table 5) it was noticed that the number days to 100 per cent flowering was least in treatment consisting of drip irrigation at 100% crop ET with white polythene mulch i.e., 34, 33.33 and 33.67 during 2020-21, 2021-22 and pooled data, respectively. The Interaction effect of 100% ET and white polythene mulch resulted in optimum vegetative growth and carbohydrate accumulation which induced early flowering, fruiting and harvesting, due to more availability of water at high stage of crop growth. Sufficient water application is important for horticultural crops, because water shortage in soil can cause flower and fruit drop as documented by Kaya *et al.* (2005) [6].

Table 5: Effect of drip irrigation and plastic mulching on days to 50 per cent flowering and days to 100 per cent flowering in cucumber

Treatment details	Days to 50 per cent flowering			Days to 100 per cent flowering		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Irrigation treatments (I)						
I_1: Drip irrigation @ 60% ET	31.22	30.89	31.06	40.33	39.56	39.94
I_2: Drip irrigation @ 80% ET	27.00	26.22	26.61	37.11	36.56	36.83
I_3: Drip irrigation @ 100% ET	25.89	25.11	25.50	34.33	33.89	34.11
S.Em. ±	0.17	0.26	0.14	0.11	0.21	0.11
CD @ 5%	0.51	0.79	0.42	0.33	0.64	0.32
Mulching treatments (M)						
M_1: White polythene mulch	27.33	26.44	26.89	36.44	35.78	36.11
M_2: Black polythene mulch	28.00	27.00	26.89	37.11	36.44	36.11
M_3:Without mulching (Control)	28.78	28.78	26.89	38.22	37.78	36.11
S.Em. ±	0.17	0.26	0.14	0.11	0.21	0.11
CD @ 5%	0.51	0.79	0.42	0.33	0.64	0.32
Interaction effect (I×M)						
I_1M_1	30.33	29.67	30.00	39.00	38.33	38.67
I_1M_2	31.33	30.67	31.00	40.33	39.33	39.83
I_1M_3	32.00	32.33	32.17	41.67	41.00	41.33
I_2M_1	26.33	25.67	26.00	36.33	35.67	36.00
I_2M_2	27.00	26.00	26.50	37.00	36.33	36.67
I_2M_3	27.67	27.00	27.33	38.00	37.67	37.83
I_3M_1	25.33	24.00	24.67	34.00	33.33	33.67
I_3M_2	25.67	24.33	25.00	34.00	33.67	33.83
I_3M_3	26.67	27.00	26.83	35.00	34.67	34.83
S.Em. ±	0.29	0.46	0.24	0.19	0.37	0.18
CD @ 5%	NS	NS	NS	0.58	NS	0.55

Crop yield parameters: The data pertaining to days for flowering on cucumber is provided in Table 5. Among irrigation levels 100 per cent crop ET (I_3) recorded significantly higher fruit weight (123.28 g, 123.94 g and 123.61g during 2020-21, 2021-22 and pooled data, respectively) over 80 per cent crop ET (I_2) and 60 per cent crop ET (I_1). Among irrigation levels 100 per cent crop ET (I_3) recorded significantly higher fruit length (15.12 cm, 15.72 cm and 15.42 cm during 2020-21, 2021-22 and pooled data, respectively) over 80 per cent crop ET (I_2) and 60 per cent crop ET (I_1). In case of fruit diameter the interaction effect was noticed it was found that the fruit diameter was maximum in treatment consisting of drip irrigation at 100% crop ET and white polythene mulch i.e., 12.77 cm, 13.50 cm and 13.13 cm during 2020-21, 2021-22 and pooled data, respectively. The maximum fruit weight fruit length and fruit diameter may be due to adequate moisture availability in the soil which might have increased various crop physiological processes, better plant nutrient uptake and higher rates of photosynthesis. This might have reflected on higher fruit weight Ngouajio *et al.* (2007) [7].

Table 6: Effect of drip irrigation and plastic mulching on fruit weight, fruit length and fruit diameter in cucumber

Treatment details	Fruit weight (g)			Fruit length (cm)			Fruit diameter (cm)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Irrigation treatments (I)									
I_1	118.56	119.24	118.90	12.61	13.11	12.86	7.49	7.76	7.62
I_2	120.61	121.17	120.89	14.56	15.22	14.89	9.88	10.50	10.19
I_3	123.28	123.94	123.61	15.12	15.72	15.42	11.38	12.22	11.80
S.Em. ±	0.22	0.38	0.24	0.22	0.30	0.19	0.08	0.35	0.19
CD @ 5%	0.67	1.13	0.71	0.67	0.91	0.56	0.23	1.05	0.56
Mulching treatments (M)									
M_1	122.00	122.83	122.36	15.06	15.89	15.47	10.34	10.92	10.63
M_2	121.89	121.26	121.04	14.17	14.67	14.42	9.82	10.29	10.06
M_3	120.29	120.27	120.00	13.07	13.50	13.28	8.58	9.27	8.92
S.Em. ±	0.22	0.38	0.24	0.22	0.30	0.19	0.08	0.35	0.19
CD @ 5%	0.67	1.13	0.71	0.67	0.91	0.56	0.23	1.05	0.56
Interaction effect (I×M)									
I_1M_1	119.00	120.33	119.67	13.00	13.67	13.33	7.77	8.27	8.02
I_1M_2	118.47	118.93	118.70	12.83	13.17	13.00	7.90	8.13	8.02
I_1M_3	118.20	118.47	118.33	12.00	12.50	12.25	6.80	6.87	6.83
I_2M_1	121.50	122.17	121.83	16.00	17.00	16.50	10.50	11.00	10.75
I_2M_2	120.83	121.17	121.00	14.17	14.50	14.33	10.17	10.50	10.33
I_2M_3	119.50	120.17	119.83	13.50	14.17	13.83	8.97	10.00	9.48
I_3M_1	125.17	126.00	125.58	16.17	17.00	16.58	12.77	13.50	13.13
I_3M_2	123.17	123.67	123.42	15.50	16.33	15.92	11.40	12.23	11.82
I_3M_3	121.50	122.17	121.83	13.70	13.83	13.77	9.97	10.93	10.45
S.Em. ±	0.39	0.66	0.41	0.39	0.52	0.32	0.13	0.61	0.33
CD @ 5%	1.16	NS	NS	NS	NS	0.98	0.39	NS	NS

The data pertaining to number of fruits per plant, yield per plant and yield per ha area of cucumber is provided in Table 7. In the interaction effect it was noticed that the number of fruits per plant was maximum in treatment consisting of drip irrigation at 100% crop ET and white polythene mulch i.e., 19.70, 24 and 21.85 during 2020-21, 2021-22 and pooled data, respectively. In case of fruit yield per plant the interaction effect was noticed that the yield per plant was maximum in treatment consisting of drip irrigation at 100% crop ET and white polythene mulch i.e., 2.60 kg, 2.93 kg and 2.77 kg during 2020-21, 2021-22 and pooled data, respectively. When the interaction effect it was found that the total yield per hectare was maximum in treatment consisting of drip irrigation at 100% crop ET and white polythene mulch i.e., 104.00 t ha^{-1}, 117.30 t ha^{-1} and 110.70 t ha^{-1} during 2020-21, 2021-22 and pooled data, respectively.

Table 7: Effect of drip irrigation and plastic mulching on number of fruits per plant, yield per plant and yield per plot in cucumber

Treatment details	Number of fruits per plant			Yield per plant (kg)			Yield (t ha^{-1})		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Irrigation treatments (I)									
I_1	17.02	18.14	17.58	2.17	2.21	2.19	86.80	88.40	87.60
I_2	18.19	18.91	18.55	2.36	2.58	2.47	94.40	103.10	98.80
I_3	18.88	22.00	20.44	2.48	2.86	2.67	99.10	114.30	106.70
S.Em. ±	0.06	0.25	0.13	0.02	0.05	0.03	0.90	2.20	1.00
CD @ 5%	0.19	0.76	0.38	0.07	0.16	0.08	2.90	6.50	3.10
Mulching treatments (M)									
M_1	18.59	24.00	19.63	2.43	2.67	2.55	97.10	106.70	101.90
M_2	18.26	23.00	19.18	2.40	2.58	2.49	96.10	103.10	99.60
M_3	17.24	19.00	17.77	2.18	2.40	2.29	87.10	96.00	91.60
S.Em. ±	0.06	0.25	0.13	0.02	0.05	0.03	0.90	2.20	1.00
CD @ 5%	0.19	0.76	0.38	0.07	0.16	0.08	2.90	6.50	3.10

Interaction effect (I×M)									
I_1M_1	17.47	18.50	17.98	2.23	2.33	2.28	89.30	93.30	91.30
I_1M_2	17.30	18.17	17.73	2.24	2.20	2.22	89.70	88.00	88.90
I_1M_3	16.30	17.77	17.03	2.03	2.10	2.07	81.30	84.00	82.70
I_2M_1	18.60	19.50	19.05	2.45	2.73	2.59	98.00	109.30	103.70
I_2M_2	18.50	19.13	18.82	2.43	2.63	2.53	97.30	105.30	101.30
I_2M_3	17.47	18.10	17.78	2.20	2.37	2.28	88.00	94.70	91.30
I_3M_1	19.70	24.00	21.85	2.60	2.93	2.77	104.00	117.30	110.70
I_3M_2	18.97	23.00	20.98	2.53	2.90	2.72	101.30	116.00	108.70
I_3M_3	17.97	19.00	18.48	2.30	2.74	2.52	92.00	109.50	100.70
S.Em. ±	0.11	0.44	0.22	0.04	0.09	0.04	1.69	3.80	1.80
CD @ 5%	0.33	1.31	0.65	NS	NS	NS	NS	NS	NS

Higher soil moisture content maintained under plastic mulched treatments and better control of weeds when compared to un mulched plots had positively reflected on the vegetative and yield parameters. Consequently, use of plastic mulch as soil cover increased the yield of cucumber in the current trial. Mulch is a covering placed over the soil around the plants. Plastic mulch on the surface of the soil causes change in the microclimate around the plants. This results in moisture conservation, less soil compaction and higher CO_2 levels around plants. Mulching is an effective method of manipulating the crop growing environment to increase crop yield and improve product quality by controlling soil temperature, retaining soil moisture and reducing soil evaporation Chakraborty *et al*. (2008) [1].

Conclusion

The growth parameters such as vine length, number of leaves per plant, stem girth, leaf area and leaf area index at 30, 45 and 60 DAS, recorded best under 100% crop ET with white polythene mulch (I_3M_1), this was on par with100% crop ET with black polythene mulch (I_3M_2). The plastic mulch treatments significantly improved the growth of the crop compared to no mulch treatments during 2020-21 and 2021-22.

The crop yield was higher (104.00 t ha^{-1}, 117.30 t ha^{-1} and 110.70 t ha^{-1}) in treatment consisting of drip irrigation at 100% crop ET with white polythene mulch during 2020-21, 2021-22 and pooled data, respectively. This was followed by 100% crop ET with black polythene mulch. Similar trend was observed in yield per plant, yield per plot, yield per m^2, yield per 1000 m^2 during 2020-21, 2021-22 and pooled data, respectively.

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