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Influence of deficit irrigation, mulching and micronutrients (Boron and Copper) on fruit quality of Litchi cv. Rose Scented

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Abstract
The present trial was conducted to evaluate the irrigation levels, mulching and micronutrient on quality of Litchi. The trial composed of 21 treatment combinations and 3 replications. The results of the study revealed that maximum T.S.S. and ascorbic acid content was recorded under MDI_3Cu. Minimum acidity was noticed under MDI_3B. Besides, maximum value of anthocyanin content was found under MDI_4B. Hence, from the present study, it is revealed that from mulches with drip irrigation regimes of 75 and 100 % evaporative replenishment were recorded best from fruit quality point of view. However, maximum anthocyanin content was observed under MDI_4B.

Keywords: Influence, irrigation, micronutrients, rose scented

Introduction
Litchi, botanically known as (*Litchi chinensis* Sonn.) is an important pomological crop which is native to the region ranging between southern China, northern Vietnam and Malaysia, lies between latitudes 23°N and 27°N (Mitra and Pathak, 2010) [7]. It was reached to Burma from china and it was introduced in India via Myanmar at the end of 17th century (Huang *et al*., 2005) [4]. Among the litchi growing nations, India ranks 2nd next only to china in terms of production (Sahni *et al*., 2020) [9]. In India, Litchi ranks 10th and 11th in terms of the area and production respectively among the major fruits crop being (Sravani, 2021) [12].
Drip irrigation has proven to be highly successful under varied Indian condition. It provides trees the required irrigation at and near root zone where water is actually needed and absorbed by the roots. It enhances the water productivity (Fereres and Soriano, 2007) [1]. Moreover, it also reduces the wastage of water. Similarly, mulch has a tremendous role in reducing the evaporation losses and maintains the turgidity in canopy of tree. Use of plastic mulch aids in soil conservation, weed control, plant protection ultimately helps yield enhancement (Singh *et al*. 2010) [10]. Along with the major essential elements, litchi crop needs minor amount of micronutrients such as boron and copper for obtaining better yield. Boron in the form of soil or foliar application has role in pollination, fruit quality, fruit cracking reduction, storage capability and tolerance to stress. Cracking of litchi fruit is mainly attributed to boron deficiency. Beside this, Copper helps in improving the quality of fruits. In order to evaluate the combined effect of these factors, the study was conducted.

Material and Methods
The present study was carried out at Horticulture Research Centre, Patharchatta, Pantnagar. The trial was started 2019 on 19 year old bearing orchard of litchi cultivar Rose Scented. The site is situated in the tarai region in the foothills of Himalayas at 29˚ North Latitude and 79.3˚ East longitude. The altitude of the place is 243.84m above the mean sea level. The experimental site was silty clay loam has a pH of 6.14 and organic content of 0.53%. Litchi trees during initial fruit developmental stages were given deficit drip irrigation with/without mulch. Further, micronutrient spray of borax as source of boron and copper sulphate as the source of copper was also done both at the rate of 2 gram per tree. The study was conducted for 2 years (2018-19 and 2019-20) and pooled data of the study has is being presented here. There were 21 treatment combinations replicated 3 times. The statistical analysis was done using 3 factorial randomized block design. The treatment combination followed during course of study is mentioned as under in Table 1.

Table 1: Treatment combinations followed during study.

S. No.	Treatment symbol	Treatment combinations
1.	MDI_1B	Mulch+25% of estimated water requirement+ Borax@ 2g/litre
2.	MDI_1Cu	Mulch+25% of estimated water requirement + CuSo4 @ 2 g/litre.
3.	MDI_2B	Mulch+50% of estimated water requirement+ Borax@ 2g/litre
4.	MDI_2Cu	Mulch+50% of estimated water requirement + CuSo4@ 2 g/litre
5.	MDI_3B	Mulch+75% of estimated water requirement + Borax@ 2g/litre
6.	MDI_3Cu	Mulch+75% of estimated water requirement + CuSo4 @ 2 g/litre.
7.	MDI_4B	Mulch+100% of estimated water requirement + Borax@ 2g/litre
8.	MDI_4Cu	Mulch+100% of estimated water requirement + CuSo4@ 2 g/litre.
9.	MDI_5B	Mulch+125% of estimated water requirement + Borax@ 2g/litre
10.	MDI_5Cu	Mulch+125% of estimated water requirement + CuSo4@ 2 g/litre.
11.	M_0DI_1B	25% of estimated water requirement+ Borax@ 2g/litre
12.	M_0DI_1Cu	25% of estimated water requirement + CuSo4@ 2 g/litre.
13.	M_0DI_2B	50% of estimated water requirement+ Borax@ 2g/litre
14.	M_0DI_2Cu	50% of estimated water requirement + CuSo4@ 2 g/litre
15.	M_0DI_3B	75% of estimated water requirement + Borax@ 2g/litre
16.	M_0DI_3Cu	75% of estimated water requirement + CuSo4@ 2 g/litre.
17.	M_0DI_4B	100% of estimated water requirement + Borax@ 2g/litre
18.	M_0DI_4Cu	100% of estimated water requirement + CuSo4@ 2 g/litre.
19.	M_0DI_5B	125% of estimated water requirement + Borax@ 2g/litre
20.	M_0DI_5Cu	125% of estimated water requirement + CuSo4@ 2 g/litre.
21.	Control	Surface water 100% of estimated water requirement

Estimated irrigation water requirement (Id) based on crop evapotranspiration in litres/plant was calculated according to (Vermeiren and Jobling, 1984) as following:

$V = E_p \times K_p \times K_c \times K_r \times$ Ground cover area

Where,
E_p: Pan evaporation (mm/day)
K_p: Pan Coefficient (0.85)
K_c: Crop coefficient (0.65)
K_r: Reduction coefficient (0.1+ per cent ground cover)

Result and Discussion

1. TSS

The data related to effect of mulch, drip irrigation and foliar application on total soluble solids (per cent) of litchi (Table 1) showcased that the highest (19.64 per cent, 19.65 per cent and 19.65 per cent) amount of total soluble solids were observed under treatment MDI_3Cu (mulch with drip irrigation at 75 per cent water requirement and foliar application of copper sulphate @ 2 g/litre, while the lowest amount (18.14, 17.85 and 17.99 per cent) was found in control for 2019, 2020 and pooled mean respectively.

Table 1: Effect of drip irrigation, mulching and foliar application of boron and copper on TSS (%) of litchi

Year		2019			2020			Pooled		
Mulch	Irrigation levels	Micronutrients		Mean	Micronutrients		Mean	Micronutrients		Mean
		B	Cu	(M x Dl)	B	Cu	(M x Dl)	B	Cu	(M x Dl)
M	Dl_1	18.57	18.71	18.64	18.76	18.50	18.63	18.66	18.60	18.63
	Dl_2	19.19	19.26	19.22	19.45	19.50	19.48	19.32	19.38	19.35
	Dl_3	19.55	19.64	19.60	19.56	19.65	19.60	19.55	19.65	19.60
	Dl_4	19.43	19.41	19.42	19.47	19.20	19.34	19.45	19.31	19.38
	Dl_5	19.06	19.00	19.03	18.95	19.15	19.05	19.01	19.07	19.04
	Mean (M x F)	19.16	19.20	19.18	19.24	19.20	19.22	19.20	19.20	19.20
M_0	Dl_1	18.28	18.23	18.26	18.45	18.30	18.38	18.37	18.27	18.32
	Dl_2	18.50	18.33	18.41	18.75	18.70	18.73	18.62	18.52	18.57
	Dl_3	19.46	19.57	19.52	19.50	19.45	19.48	19.48	19.51	19.50
	Dl_4	19.21	19.28	19.24	19.00	19.15	19.08	19.10	19.21	19.16
	Dl_5	18.59	18.71	18.65	19.10	18.12	18.61	18.84	18.42	18.63
	Mean (M x F)	18.81	18.82	18.81	18.96	18.75	18.85	18.88	18.78	18.83
DlxF	Dl_1	18.43	18.47	18.45	18.61	18.40	18.50	18.52	18.43	18.48
	Dl_2	18.84	18.79	18.82	19.10	19.10	19.10	18.97	18.95	18.96
	Dl_3	19.51	19.61	19.56	19.53	19.55	19.54	19.52	19.58	19.55
	Dl_4	19.32	19.34	19.33	19.24	19.18	19.21	19.28	19.26	19.27
	Dl_5	18.82	18.85	18.84	19.03	18.64	18.83	18.92	18.74	18.83
	Mean (F)	18.98	19.01		19.10	18.97		19.04	18.99	
	Control	18.14			17.85			17.99		
	Factor	M	Dl	F	M x Dl	Dl x F	M x F	M x Dl x F		
CD at 5%	2019	0.024	0.038	0.024	0.054	0.054	NS	0.076		
	2020	0.049	0.077	0.049	0.109	0.109	0.069	0.154		
	Pooled	0.027	0.042	0.027	0.060	0.060	0.038	0.084		

It was followed by M_0DI_1Cu (no mulch with drip irrigation at 50 per cent estimated water requirement and foliar application of copper sulphate @ 2 g/litre) having T.S.S. of 18.23 and 18.27 per cent were observed under during the year 2019 and in pooled data, respectively. Moreover, during year 2020, control was followed by M_0DI_5Cu (no mulch with drip irrigation at 125 per cent estimated water requirement and foliar application of copper sulphate @ 2 g/litre) having T.S.S. of 18.12 per cent. The results of both the years (2019 and 2020) and in pooled demonstrated significantly higher T.S.S under mulched treatments *i.e.* 19.18 per cent, 19.22 per cent and 19.20 per cent, respectively as compared to un-mulched. Further, the application of drip irrigation at 75 per cent water requirement significantly augmented the T.S.S (19.56 per cent, 19.54 pr cent and 19.55 per cent) in both the years as well as in pooled. Foliar application also significantly affected the T.S.S, wherein maximum T.S.S was governed under the treatment foliar application of borax @ 2 g/litre during first year while, the maximum TSS was found under treatment foliar application of copper sulphate @ 2 g/litre during 2020 and in pooled data. Further, the interaction of mulch with drip irrigation at 75 per cent water requirement was found significantly superior over remaining mulch drip irrigation interactions, during the entire study.

The highest TSS were found under MDI_3Cu, while the lowest under M_0DI_1Cu. This could be attributed to the availability of optimum soil temperature, moisture and nutrient supply under mulch in association with drip irrigation, while under M_0DI_1Cu due to absence of mulch, soil temperature fluctuations and moisture evaporation losses were quite common resulting into poor uptake and assimilation and subsequently low T.S.S content. In accordance with these findings, Mulches ensures optimum soil moisture as a result of reduced evaporation from the soil surface eventually leads to increment in soluble solids content. Gupta (2018) [3] in Litchi and Preet (2020) [8] in guava cv. VNR Bihi as they recorded higher soluble solid under various mulches as compared with unmulched condition.

2. Acidity (%)

Table 2 represented that the mulch, drip irrigation and foliar application on acidity (per cent) of litchi and revealed significant differences for acidity among different treatment combinations. The highest acidity (0.64 per cent, 0.62 per cent and 0.63 per cent) was found under control while lowest (0.39 per cent, 0.38 per cent and 0.39 per cent) under MDI_3B (mulch with drip irrigation at 75 per cent water requirement and foliar application of borax @ 2 g/litre), during both the years as well as pooled mean, respectively. It was closely followed by MDI_3Cu (mulch with drip irrigation at 75 per cent water requirement and foliar application of copper sulphate @ 2 g/litre) and M_0DI_3B (drip irrigation at 75 per cent water requirement and foliar application of borax @ 2 g/litre with no mulch each having acidity of 0.40 per cent. While, by M_0DI_3B *i.e.* 0.41 each for both 2020 and pooled mean.

Table 2: Effect of drip irrigation, mulching and foliar application of boron and copper on acidity (%) of litchi

Year		2019			2020			Pooled		
Mulch	Irrigation levels	Micronutrients		Mean	Micronutrients		Mean	Micronutrients		Mean
		B	Cu	(M x Dl)	B	Cu	(M x Dl)	B	Cu	(M x Dl)
M	Dl_1	0.53	0.53	0.53	0.56	0.51	0.53	0.55	0.52	0.53
	Dl_2	0.50	0.51	0.51	0.53	0.49	0.51	0.52	0.50	0.51
	Dl_3	0.39	0.40	0.40	0.38	0.41	0.39	0.39	0.41	0.40
	Dl_4	0.44	0.43	0.44	0.44	0.42	0.43	0.44	0.43	0.43
	Dl_5	0.41	0.41	0.41	0.48	0.51	0.49	0.45	0.46	0.45
	Mean (M x F)	0.46	0.46	0.46	0.48	0.47	0.47	0.47	0.46	0.46
M_0	Dl_1	0.56	0.55	0.56	0.58	0.55	0.57	0.57	0.55	0.56
	Dl_2	0.52	0.51	0.52	0.42	0.46	0.44	0.47	0.49	0.48
	Dl_3	0.40	0.41	0.41	0.44	0.44	0.44	0.42	0.43	0.42
	Dl_4	0.44	0.45	0.45	0.55	0.50	0.53	0.50	0.48	0.49
	Dl_5	0.47	0.47	0.47	0.46	0.45	0.45	0.46	0.46	0.46
	Mean (M x F)	0.48	0.48	0.48	0.49	0.48	0.48	0.48	0.48	0.48
DlxF	Dl_1	0.55	0.54	0.54	0.57	0.53	0.55	0.56	0.53	0.55
	Dl_2	0.51	0.51	0.51	0.48	0.48	0.48	0.49	0.49	0.49
	Dl_3	0.40	0.41	0.40	0.41	0.43	0.42	0.40	0.42	0.41
	Dl_4	0.44	0.44	0.44	0.50	0.46	0.48	0.47	0.45	0.46
	Dl_5	0.44	0.44	0.44	0.47	0.48	0.47	0.45	0.46	0.46
	Mean (F)	0.47	0.47		0.48	0.47		0.48	0.47	
	Control	0.64			0.62			0.63		
	Factor	M	Dl	F	M x Dl	Dl x F	M x F	M x Dl x F		
CD at 5%	2019	0.003	0.005	NS	0.007	NS	NS	0.009		
	2020	0.011	0.017	NS	0.024	0.024	NS	0.034		
	Pooled	NS	0.009	NS	0.012	0.012	NS	0.017		

The data under all treatments (excluding control) were also statistically analysed and observed that the main effect of mulch was significant on acidity during first year (2019) and second year (2020) while, non-significant in the pooled mean. Drip irrigation at 25 per cent produced significantly higher acidity (0.54 per cent, 0.55 per cent and 0.55 per cent) while the lowest (0.44 per cent) was observed under irrigation at 100 per cent water requirement, during both the years and in pooled, respectively. Foliar application on the other hand, exhibited no significant effect on acidity. The combined effect of mulch with drip irrigation at 25 per cent water requirement obtained highest (0.56 per cent, 0.57 per cent and 0.56 per cent) acidity in both the years and in pooled. The interaction effect of drip irrigation and foliar application was also found

significant during second year and in pooled mean. Likewise, the combination of mulch with foliar application resulted in non-significant difference in the entire course of study with maximum acidity *i.e.* 0.48 per cent under no mulch with foliar application of borax @ 2 g/litre (M_0B), respectively. Overall, the study showed that the interactive effect of no mulch with drip irrigation at 25 per cent water requirement and foliar application of borax @ 2 g/litre (0.56, 0.58 and 0.57 per cent) were significantly superior in both the year and in pooled, respectively.

The acidity significantly varied among the different treatment combinations including control which could be attributed to the differences in the availability and distribution of soil moisture and nutrients in the root zone under drip irrigation as compared to control. Further, under the varying irrigation levels, the acidity reduced with the increase in the irrigation and could be attributed to the favourable moisture and nutrient supply throughout the whole fruit development stage due to the combined influence of all the three factors which promoted the enzymatic activity and further favoured the hydrolysis of metabolites (such as organic acids) resulting into reduced acidity level, under drip irrigation and foliar application in association with mulch. The prevalence of high acidity under no mulch and low acidity under mulched conditions was also reported by Khan *et al*., (2013) [5] in guava cv. Allahabad Safeda. In line with these results, decline in titrable acidity was also found in guava cv. Shweta when irrigated at 100 per cent level under drip irrigation (Ramnivas *et al*., 2013). Tyagi (2017) [13] obtained significant result with mulch and drip irrigation and got least acidity with 75 and 100% ER with mulch.

3. Ascorbic acid

The results (Table 3) showed mulch, drip irrigation and foliar application on ascorbic acid (mg/100g) of litchi *viz.* ascorbic acid varied significantly among the treatment combinations with the maximum value obtained under MDI_3Cu (26.15 mg/100g, 26.24 mg/100g and 26.19 mg/100g) *i.e.* mulch with drip irrigation at 75 per cent water requirement and foliar application of copper sulphate @ 2 g/litre while the lowest amount was found under control (20.78 mg/100g) during first year and while, the minimum ascorbic acid was 22.05 mg per 100 g and 22.14 mg per 100 g due to mulch with drip irrigation at 25 per cent water requirement and foliar application of borax @ 2 g/litre (M_0DI_1Cu) in second year and in pooled, respectively. Furthermore, control also shared the lowest position for pooled mean along with M_0DI_1Cu having 21.44 mg/100g ascorbic acid. The results showed that mulched treatments exhibited significantly higher ascorbic acid (24.52 mg/100 g, 24.66 mg/100 g and 24.59 mg/100g) over unmulched treatments, during both the years as well as pooled analysis, respectively. The treatment receiving drip irrigation at higher level showcased more ascorbic acid content *i.e.* 25.13 mg/100 g, 25.44 mg/100g and 25.28 mg/100 g) during both the year and in pooled data. The combination of mulch with drip irrigation at 75 per cent level produced maximum ascorbic acid content *viz.* 26.02 mg/100 g, 26.17 mg/100g and 26.10 mg/100 g, in both the years and in pooled, respectively.

Table 3: Effect of drip irrigation, mulching and foliar application of boron and copper on ascorbic acid of litchi

Year		2019			2020			Pooled		
Mulch	Irrigation levels	Micronutrients		Mean	Micronutrients		Mean	Micronutrients		Mean
		B	Cu	(M x Dl)	B	Cu	(M x Dl)	B	Cu	(M x Dl)
M	Dl_1	22.47	22.60	22.54	22.61	22.84	22.73	22.54	22.72	22.63
	Dl_2	23.46	23.16	23.31	23.50	23.40	23.45	23.48	23.28	23.38
	Dl_3	25.90	26.15	26.02	26.10	26.24	26.17	26.00	26.19	26.10
	Dl_4	25.24	25.10	25.17	25.31	25.25	25.28	25.28	25.18	25.23
	Dl_5	25.50	25.62	25.56	25.65	25.72	25.69	25.57	25.67	25.62
	Mean (M x F)	24.52	24.53	24.52	24.63	24.69	24.66	24.57	24.61	24.59
M_0	Dl_1	22.22	22.17	22.20	22.05	22.12	22.09	22.14	22.15	22.14
	Dl_2	23.06	22.91	22.99	22.92	22.88	22.90	22.99	22.90	22.94
	Dl_3	24.25	24.22	24.24	24.95	24.46	24.71	24.60	24.34	24.47
	Dl_4	22.98	23.12	23.05	22.81	23.05	22.93	22.90	23.09	22.99
	Dl_5	23.58	23.53	23.56	23.45	23.39	23.42	23.52	23.46	23.49
	Mean (M x F)	23.22	23.19	23.21	23.24	23.18	23.21	23.23	23.19	23.21
DlxF	Dl_1	22.35	22.39	22.37	22.33	22.48	22.41	22.34	22.43	22.39
	Dl_2	23.26	23.04	23.15	23.21	23.14	23.18	23.24	23.09	23.16
	Dl_3	25.08	25.19	25.13	25.53	25.35	25.44	25.30	25.27	25.28
	Dl_4	24.11	24.11	24.11	24.06	24.15	24.11	24.09	24.13	24.11
	Dl_5	24.54	24.57	24.56	24.55	24.56	24.55	24.55	24.56	24.55
	Mean (F)	23.87	23.86		23.94	23.94		23.90	23.90	
	Control	20.78			22.10			21.44		
	Factor	M	Dl	F	M x Dl	Dl x F	M x F	M x Dl x F		
CD at 5%	2019	0.057	0.089	NS	0.126	0.126	NS	0.179		
	2020	0.082	0.130	NS	0.184	NS	NS	0.260		
	Pooled	0.049	0.078	NS	0.110	0.110	NS	0.155		

Further in both the years, the interactive effect of drip irrigation at 75 per cent level with foliar application of copper sulphate @ 2 g/litre produced significantly superior results during first year, but were recorded maximum ascorbic acid in second year and in pooled due to drip irrigation at 75 per cent water requirement with foliar application of borax @ 2 g/ltire. Above all the entire course of study determined that the combined effect of mulch with drip irrigation at 75 per cent level and foliar application of copper sulphate @ 2 g/litre gave superior results (26.15 mg/100g, 26.24 mg/100g and

26.19 mg/100g) as compared to other combinations. However, the interactive effect of mulch with foliar application were observed non-significant variation in both the years and in pooled. The maximum ascorbic acid was found under MDI_3Cu which could be due to the combined influence of mulch, drip irrigation and foliar application that provided a favourable environment in the rhizosphere resulting in better moisture and nutrient uptake, while minimum ascorbic acid under the treatment combination M_0DI_1Cu could be attributed to the poor soil moisture and nutrient availability owing to low irrigation and foliar application level along with no mulch condition which might had augmented the evaporation losses besides fluctuating soil temperature.

Singh *et al*., (2015) [11] also found higher ascorbic acid content under mulch but in combination with drip irrigation at 80 per cent pan evaporation level. Similar results were also concluded by Ghosh and Pal (2010) [2]. Gupta (2018) [3] and Lal (2020) [6] found higher ascorbic acid under 75% ER drip irrigation coupled with mulch.

4. Anthocyanin content

The efficacy of anthocyanin content with regards to mulch, drip irrigation and foliar application is represented in Table 4 and observed that In the year 2019, the maximum anthocyanin content (*i.e.* 44.92 mg/100g) was found under treatment combination MDI_3B (mulch with drip irrigation at 75 per cent water requirement and foliar application of borax @ 2 g/litre), whereas the minimum (*i.e.* 31.60 mg/100g) was revealed under M_0DI_1B (no mulch with drip irrigation at 25 per cent water requirement and foliar application of borax @ 2 g/litre). During 2020 and in pooled, the highest (55.75 and 49.79 mg/100g) and lowest (13.10 and 22.50 mg/100g) anthocyanin content under MDI_4B (mulch with drip irrigation at 100 per cent water requirement and foliar application of borax @ 2 g/litre) and M_0DI_1Cu (without mulch with drip irrigation at 25 per cent water requirement and foliar application of copper sulphate @ 2 g/litre), respectively.

Table 4: Effect of drip irrigation, mulching and foliar application of boron and copper on anthocyanin content of litchi

Year		2019			2020			Pooled		
Mulch	Irrigation levels	Micronutrients		Mean	Micronutrients		Mean	Micronutrients		Mean
		B	Cu	(M x Dl)	B	Cu	(M x Dl)	B	Cu	(M x Dl)
M	Dl_1	32.93	32.77	32.85	30.44	28.50	29.47	31.68	30.64	31.16
	Dl_2	34.18	34.80	34.49	45.00	43.40	44.20	39.59	39.10	39.35
	Dl_3	44.92	44.71	44.82	46.55	45.10	45.83	45.74	44.91	45.32
	Dl_4	43.82	43.87	43.85	55.75	52.32	54.04	49.79	48.10	48.94
	Dl_5	41.74	42.18	41.96	43.90	41.15	42.52	42.82	41.67	42.24
	Mean (M x F)	39.52	39.67	39.59	44.33	42.09	43.21	41.92	40.88	41.40
M_0	Dl_1	31.60	31.91	31.76	13.50	13.10	13.30	22.55	22.50	22.53
	Dl_2	32.73	32.99	32.86	25.41	24.65	25.03	29.07	28.82	28.94
	Dl_3	38.82	39.65	39.23	33.44	30.75	32.10	36.13	35.20	35.66
	Dl_4	37.12	36.83	36.98	40.45	38.10	39.28	38.79	37.46	38.13
	Dl_5	34.89	35.10	35.00	40.11	37.41	38.76	37.50	36.25	36.88
	Mean (M x F)	35.03	35.29	35.16	30.58	28.80	29.69	32.81	32.05	32.43
DlxF	Dl_1	32.27	32.34	32.30	21.97	20.80	21.39	27.12	26.57	26.84
	Dl_2	33.45	33.89	33.67	35.21	34.02	34.61	34.33	33.96	34.14
	Dl_3	41.87	42.18	42.03	40.00	37.93	38.96	40.93	40.05	40.49
	Dl_4	40.47	40.35	40.41	48.10	45.21	46.66	44.29	42.78	43.53
	Dl_5	38.32	38.64	38.48	42.00	39.28	40.64	40.16	38.96	39.56
	Mean (F)	37.28	37.48		37.46	35.45		37.37	36.46	
	Control	34.18			38.75			36.47		
	Factor	M	Dl	F	M x Dl	Dl x F	M x F	M x Dl x F		
CD at 5%	2019	0.129	0.203	0.129	0.287	NS	NS	0.407		
	2020	0.406	0.642	0.406	0.908	0.908	NS	NS		
	Pooled	0.21	0.33	0.21	0.47	0.47	NS	0.66		

The data under different treatment combinations (excluding control) were also indicated significant effect of mulch, drip irrigation and foliar application on the anthocyanin content of litchi fruits during both the years as well as in pooled analysis. Further, under the integrated effect of mulch with drip irrigation, it was found that mulch with drip irrigation at 75 per cent level exhibited highest anthocyanin *i.e.* 44.82 mg/100g in 2019, while, the maximum anthocyanin content (55.4 and 49.94 mg/100g) under treatment mulch with drip irrigation at 100 per cent during 2020 and in pooled, respectively. During 2019 also found that the combined effect of drip irrigation at 75 per cent level with foliar application of copper sulphate @ 2 g/litre) was observed maximum anthocyanin *i.e.* 42.18 mg/100g and during 2020 and in pooled also recorded the maximum anthocyanin *i.e.* 48.10 and 44.29 mg/100g) content under treatment drip irrigation at 100 per cent water requirement and foliar application of borax @ 2 g/litre, respectively. Non-significant differences were recorded for the integrated effect of mulch and foliar application during both the years and in pooled. The study overall indicated that the treatment combination MDI_3B revealed highest anthocyanin content in 2019 as well as MDI_4B in 2020.

Further, the increasing drip irrigation level also improved the anthocyanin content which could have been the result of better nutrient availability and absorption. But the present study revealed no influence of mulch on anthocyanin content. However Zhang *et al*., (2013) [15] found that ground mulch significantly enhanced the anthocyanin concentration in blueberry fruits cv. ONeal. Lal (2020) [6] noted maximum anthocyanin content with drip irrigation at 75% ER along with black polythene mulch.

Conclusion

From the above findings obtained in present research, it can be concluded that from quality point of view, drip irrigation regimes of 75 and 100 % evaporative replenishment were recorded best from fruit quality point of view. However, maximum anthocyanin content was observed under MDI_4B. With respect to taste, 75 % ER drip irrigation coupled with mulch in association with Borax spray was found useful.

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