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Influence of Growing Environment on Growth and Yield Parameters of Coriander under Shade Net and Open Field Condition

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An experiment was conducted at Horticultural College and Research Institute, Coimbatore, during 2017-18 to study the production potentials of CO (CR) 4 coriander sown under shade net house and open field environmental conditions. Observations on biometric and quality traits were recorded at every month of sowing so as to study the environmental influence on growth and yield of foliage coriander. Among the growing conditions, the plants grown under shade net house exhibited superior performance in terms of growth, yield and good quality on leafy coriander. The days taken for germination was earlier (7.67) in the seeds sown during October under shade net house condition compared to open field condition. The vegetative and yield attributes *viz.,* plant height (29.88 cm), number of leaves (39.56) and yield (5.69 kg/plot) was found to be the highest during the month of October sown seeds followed by September month in green house condition. Whereas, in open condition sowing during the months of March, April and May seeds does not germinated which resulted in crop failure. In this study the yield was almost tripled under shade net house condition, as compared to open field condition.

Key words: Coriander, Months, Shade net, Open field, Growth parameters.

Coriander (*Coriandrum sativum* L.)is a tropical and sub-tropical crop. The word coriander is derived from the Greek name 'korion' which means bugDiederichsen (1996). It is considered as both an aromatic and spice crop. When the aromatic plant is consumed fresh, it is considered as herb which is called cilantro, green coriander, and Chinese parsley and grains are used as spice. Leaves are mostly rich in vitamin A, vitamin C and vitamin K. It is mainly grown during the month of October for leafy purpose and the performance was poor during summer months. The year round production of coriander can be availed by utilizing the protected cultivation technologies. Growing under protected condition increases the possibility of making produce available in the market when it is in great demand. In mild climate, coriander can be grown round the year for leaf purpose provided moisture is made available. Growers can cultivate a crop in any season under shade net/ polyhouse by adjusting the microclimate required by the plant species. The prevalence of varied climatic conditions i.e., in South India, the summer starts from April to June and rainy season starts from June to October. While, in North India, the summer season starts from April and ends in July and rainy season starts from July to October, besides harsh winter from November to February. Differences in changes in microclimate at different stages of crop growth can be offered by varying dates of sowing in coriander. Hence, the study was under taken to study the performance of leafy coriander during different months of sowing under open field and shade net house conditions.

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Material and Methods

The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications. In the present experiment CO (CR) 4 variety of coriander collected form the Department of Spices and Plantation crops, HC&RI, Coimbatore were evaluated under two environments *viz.*, open field condition (G1) and shade net condition (G2) and different months of sowing *viz.,* from September (S1), October (S2), November (S3), December (S4), January (S5), February (S6), March (S7), April (S8), May (S9) thus, making total eighteen treatment combinations.

The seeds were sown every months in raised beds (1×2m) with the spacing of 30 × 10 cm. The plots were applied with FYM @ 10 t per hectare at the time of last ploughing. Fertilizers were applied at the rate of 30: 40: 20 kg of NPK per hectare. The green leaves were harvested in early morning when they attained a marketable stage. Observations on growth parameters (Days taken for germination, plant height, Number of leaves, Number of primary branches at 35 DAS and at the time of harvesting stage) and yield were recorded. Five plants from each plot were tagged to record the observation. The recorded data were subjected to statistical analysis using the analysis of variance technique Panse and Sukhatme(1985).

Result and Discussion

Days taken for germination

Days taken for germination was significantly affected by time of sowing and different growing condition (Table 1). Early germination was observed in the month of October under both open condition (11.33 days) and shade net (7.67 days) followed by November month under open condition (11.67 days) and shade net condition (8.00 days). Among the growing condition, seeds sown under shade net found to record minimum number of days to germinate with an average of 9.48 days, whereas average number of days taken for seeds germination under open field condition was 12.39 days. During the summer months of *viz*., March, April and May, there was no germination in open field condition, thereby causing crop failure. Under shade net condition, late germination was recorded during April (11.67 days). Generally, coriander seeds can germinate and establish well in the temperature range of 22-27°C. The optimum temperature range of 21-32°C prevailed during October month under shade net and also in open condition which may be the reason for the early germination in that particular month. In open condition the crop did not germinate during summer months (March, April and May) but under the shade net conditions, the germination was not affected and the crop establishment was observed even during summer. High temperature was found to be the main limiting factor for the germination and growth of coriander Sarada *et al. (*2011). Since temperature has considerable effect on germination characters *viz.,* germination rate and days taken to germination, it is therefore the most critical factor in the determination of success or failure of crop establishment. This reduction or inhibition in germination rate at undesirable temperatures can be attributed to the reduction or inhibition of enzymatic activity which is responsible for seed germination process.

Table 1. Effect of different months of sowing and cultivation condition on days taken for germination, plant height, No of primary branches

Time of sowing (S)	Days taken for germination		Plant height (cm)		No of primary branches	
	Open (G1)	Shade (G2)	**Open (G1)**	**Shade (G2)**	**Open (G1)**	**Shade (G2)**
September	12.33	8.33	24.43	28.81	5.00	4.00
October	11.33	7.67	26.59	29.88	5.50	4.50
November	11.67	8.00	24.31	27.90	4.50	4.00
December	12.33	8.67	24.28	27.26	4.00	3.50
January	13.00	10.00	22.59	27.04	4.00	4.50
February	13.67	10.33	22.77	24.44	3.50	4.00
March	NA	11.33	NA	24.07	NA	3.50
April	NA	11.67	NA	23.54	NA	3.00
May	NA	9.33	NA	27.39	NA	4.00
Mean	12.39	9.48	24.16	24.16	4.42	3.89
SE(d)	0.3549	0.3287	0.5631	0.6843	0.0800	0.1025
CD (P=0.05)	0.7907**	0.6968 **	1.2546 **	1.4506**	0.1783**	0.2174**

NS – Non Significant and ** - Highly significant

October was the optimum sowing time for production of coriander leaf in open field without any reduction in rate of seed germination. Similar results were also reported by several researchers in coriander Kamaha and Maguire(1992), Sagarika *et al.*(2014). Moreover, another mechanism for this reduction is reduced metabolic efficiency at temperatures higher than optimum Thygerson *et al.*(2002). This showed that the summer months are not ideal for early germination of coriander under open condition.

Plant height

Significant differences in plant height was recorded under different growing condition and time of sowing (Table 1). The highest plant height of 29.88 cm was observed in October month under shade net condition. While comparing the growing conditions maximum mean plant height of 27.94 cm and 27.70 cm was recorded in shade net and open field condition respectively. During March, April and May there was no growth in open condition. Even under shade net condition minimum (24.07 cm, 23.54 cm and 27.39 cm) plant height was observed in March, April and May respectively. It appears that the decreased light penetration into middle and lower layers of canopy which decreases the auxin decompositions there by enhances the plant height Imam and Ranjbar (2000). Reports show that plant height increases with effect of shading was supported by Singh *et al.*(1994) and Tehlan and Malik(2010).

Number of primary branches per plant

The number of primary branches was significantly influenced by the time of sowing and growing conditions (Table 1). More number of primary branches were produced during October (5.50) under open field condition followed by the seeds sown in September (5.00).In shade net condition more number of primary branches were produced in

the plants sown during October and January months (4.50) followed by September, November, February and May sown plants (4.00). Among the different growing conditions, the mean number of primary branches (4.42) was higher in open field condition and it was lower in shade net condition (3.89). The growing condition influences the number of primary branches per plant. The maximum number of primary branches per plant was recorded in the crops which are grown in open field condition than that of plants grown under shade net condition. This may be due to the fact that plants grown under shade net conditions, intercept less light intensity and thus, photo-assimilates are deficient for the growth of auxiliary branches Moosavi (2014).

Number of leaves per plant

Number of leaves per plant varied significantly with time of sowing and growing condition. The results revealed that, the crop raised during October had more number of leaves per plant (35.33) in open field as well as shade net conditions (39.56). Whereas, the crop grown under shade net condition recorded the highest mean value of 34.44 leaves when compared to open condition (30.63). During March, April and May months number of leaves recorded under shade net conditions were 28.98, 26.33 and 33.70 respectively, whereas under open condition there was a crop failure (Table 2).

Table 2. Effect of different months of sowing and cultivation condition on number of leaves and yield (kg/plot)

Time of sowing (S)	No. of leaves per plant		Yield (kg/plot)	
	Open (G1)	Shade (G2)	Open (G1)	Shade (G2)
September	33.15	38.67	2.32	5.21
October	35.33	39.56	2.52	5.69
November	31.94	37.91	2.26	5.14
December	30.97	36.92	2.21	5.09
January	28.67	34.81	2.10	4.67
February	26.23	33.03	1.67	4.29
March	NA	28.98	NA	4.08
April	NA	26.33	NA	3.89
May	NA	33.70	NA	4.39
Mean	30.63	34.44	2.18	4.71
SE(d)	0.9035	0.6718	0.0282	0.0693
CD (P=0.05)	2.0132**	1.4242**	0.0628 **	0.1470**

NS – Non Significant and ** - Highly significant

Vegetative growth parameters were found to be better in shade net condition which might be due to favourable growing condition. Plants under shade produced more number of leaves which had increased photosynthetic area through the action of cell division and cell enlargement. These results were in corroborates with the findings of previous researchers Sinha *et al.* (2005).

Leaf yield

The leaf yield showed a significant variation during different months of sowing under open field and shade net condition (Table 2). The leaf yield was higher in the crop raised during October (5.69 kg/plot) followed by September (5.21 kg/plot) in shade net condition and the same trend was observed in open field condition with leaf yield of 2.52 kg/plot in the October raised crop. The mean leaf yield/plot was higher under shade net condition (4.71 kg/plot) and it was lower in the open field condition (2.18 kg/plot). This might be due to the plants sown during October month might have benefited by favourable conditions like temperature and humidity to achieve better germination, seedling vigour, maximum photosynthetic surface which led to accumulation of maximum fresh weight and dry weight than those sown during other months. The greater leaf number on October sown crop might have helped in the production of more metabolites and consequent growth accumulation of total solids which ultimately resulted in the production of larger amount of green leaf yield.

Economics of benefit cost ratio (BCR)

The cost economics of coriander cultivation under open field and shade condition during different months were worked out (Table 3). The cost economics of coriander under shade net and open field condition during different time of sowing were worked out. Among the growing condition yield was higher in October sown crop under shade net condition (24.6 t/ha). Whereas lowest yield was recorded in (8.35 t/ha) February under open field condition. There was a crop failure during the summer months of March, April and May under open field condition, hence there was no yield and the income was nil. Whereas under, shade net condition, there was year round crop production, even during the off-season there by generating considerable income.

With the yield data and cost of cultivation of coriander B:C ratio was calculated and high B:C ratio was recorded in shade net house with the October (3.78) sown crop and it was lowest in the April sown crop (2.27) under open condition. October sown crop performed better with B:C ratio of 2.1 therefore it was clear from the results that coriander cultivation under shade net condition is suitable for fetching a sustainable income throughout the year, hence more profitable.

The mean leaf yield/plot and leaf yield (t) per hectare were higher under shade net condition and it was lower in the open field condition. The B:C ratio was also high under shade net condition indicating the profitability of the crop (Fig.6). This might be also due to more plant height, number of leaves and leaf area in shade net which developed carbohydrates through photosynthesis and ultimately increased yield. Higher yield of coriander grown under net house than open field may be attributed to the better vegetative growth like plant height, number of leaves per plant, enhanced photosynthesis, accumulation

Table 3. Effect of different months of sowing and cultivation condition on B: C ratio

Time of sowing (S)	Cost economics							
	Open condition (G1)				Shade net condition (G2)			
	Yield (t/ha)	Gross income (Rs./ha)	Net Income (Rs./ha)	B:C ratio	Yield (t/ha)	Gross income (Rs./ha)	Net Income (Rs./ha)	B:C ratio
September	11.60	73905	116000	1.8	23.45	260500	201039	3.38
October	12.60	85705	126000	2.1	24.6	284500	225039	3.78
November	11.30	72705	113000	1.8	21.7	257000	197539	3.32
December	11.05	70205	110500	1.7	20.45	254500	195039	3.28
January	10.50	64705	105000	1.6	18.35	233500	174039	2.93
February	8.35	43205	83500	1.1	16.45	214500	155039	2.61
March	NA	NA	NA	NA	18.35	204000	144539	2.43
April	NA	NA	NA	NA	14.9	194500	135039	2.27
May	NA	NA	NA	NA	21.45	219500	160039	2.69

of carbohydrates, development of cell wall and cell differentiations as they boost up biological activity. Similar findings also reported by (Dabhi, 2015). Cultivation under protected environment is the technique of providing favourable environmental or growth condition to the plants. It is rather used to protect plants from the adverse climatic conditions by providing optimum conditions of light, temperature, humidity, CO_2 and air circulation for the best growth of plants to achieve maximum yield (Dixit, 2007).

Conclusion

The findings of the present research suggests farmers and agricultural researchers to consider the date of sowing which appears to be a challenging task in the context of global climatic scenario. However for better understanding reliability and validation, such studies may be conducted for several years taking into account the microclimatic factors of the particular locality.The present study revealed that sowing during October month under open field and shade net house condition is useful for the farmers to improve the yield as well the income. Also, it has proven that, cultivation under shade net house condition can improve theproduction of leafy coriander which is beneficial for farmers to double their income.

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