AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **12** | Issue 2 | December, 2017 | 211-217
Visit us -*www.researchjournal.co.in*

RESEARCH PAPER

DOI : 10.15740/HAS/TAJH/12.2/211-217

Article history :
Received : 02.10.2017
Revised : 08.11.2017
Accepted : 15.11.2017

Response of coriander cultivars under different shade net intensities during summer

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ABSTRACT : The results of present investigation indicated that, among the different shading intensities 50 per cent shading intensity recorded the minimum number days required for germination (8.00) and emergence of third leaf (13.50) as compared with remaining shading intensities. The highest number of leaves, plant height, number of branches, internodal length of leaves were observed in 50 per cent shading intensities (21.92, 19.17cm, 6.17 and 6.08 cm, respectively). The highest leaf area was observed in 50 per cent shading intensities (4.67 cm^2) while among the varieties, the variety, JD-1 recorded the highest leaf area (4.40 cm^2). The minimum days required for harvesting of coriander was recorded in 50 per cent shading intensities (36.67 days) as compared to open conditions (42.17 days). The highest yield per plot (3.40 kg) and per hectare (50.23 q) of coriander was recorded in 50 per cent shading intensity as compared to other shading intensities while highest yield per plot and per hectare was recorded variety of JD-1 (2.53 kg per plot) and (37.44 q per ha.), respectively. The interaction effect between shading intensities and variety, all the growth and yield parameters of coriander cultivars were found to be non-significant.

KEY WORDS : Shading intensities, Coriander cultivars, Germination, Growth, Yield

HOW TO CITE THIS ARTICLE : Mahajan, R. D., Patgaonkar, D. R., Garande, V. K., Pawar, R. D., Dhumal, S. S. and Sonawane, P. N. (2017). Response of coriander cultivars under different shade net intensities during summer. *Asian J. Hort.*, **12**(2) : 211-217, **DOI : 10.15740/HAS/TAJH/12.2/211-217.**

Coriander (*Coriandrum sativum* L.) is an annual herbaceous plant, native to Southern Europe and North Africa to South Western Asia. It belongs to the family of Apiaceae and is mainly cultivated from its seeds throughout the year. India is the largest producer, consumer and exporter of coriander with greater share in world export market. Global production of coriander was around 3.35 lakh MT per year. India contributes almost 80 per cent of world coriander production and produces around 3.0 lakh MT annually (Anonymous, 2014).

The green leaves of coriander are a rich source of minerals like calcium, phosphorus and iron as well as vitamin A, C, riboflavin and folic acid. The green herbs contain 160 mg/100 g vitamin C, 12 mg/100 g vitamin A (Girenko, 1982) and 87.9 per cent moisture, 3.3 per cent protein, 0.6 per cent fat, 6.5 per cent carbohydrates and 1.7 per cent mineral matter (Jangra *et al.*,2014). All parts of this herb are used as flavoring agent and traditional remedies for the treatment of different disorders in the folk medicine systems of different civilizations (Sahib *et al*., 2012). Coriander closely resembles flat leaf like parsley. This resemblance makes many people confused between these two however, coriander has strong fragrance and parsley has mild fragrance (Verma *et al.*, 2011). It is highly reputed ayurvedic medicinal plant commonly known as "*Dhaniya*" in India. Moreover, this plant is used to cure diseases like digestive tract disorders,

respiratory tract disorders, urinary tract infections. Coriander has been reported to possess many pharmacological activities like antioxidant, anti-diabetic, anti-mutagenic, antilipidemic, anti-spasmodic (Darughe *et al.,* 2012).

Summer months are not ideal for early germination of coriander as well as growth and yield. It may be due to high temperature and other climatic factors which are not suitable to speed up coriander seeds to germinate. Hence, protected cultivation in the summer days may be a possible alternative for farmers to control external climatic factors which may affect germination of coriander seeds and leaf yield. A substantial increase in yield along with enhancement in yield attributing characters was recorded in protected cultivation as compared with open condition (Dixit, 2007). Production of vegetables under shade net house has several benefits including minimum use of pesticides, off-season vegetable production, advancing maturity, increased productive period, improved quality and income per unit area is high. The control of the microclimate allows the production of higher quality products which are free from insect attack, pathogens and chemical residue. There is lot of pressure on cultivable land caused due to industrialization, urbanization and expansion of the rural areas. Therefore, it is utmost necessary to improve the productivity of leafy vegetables by adopting intensive cultivation under shade nets during summer season. Therefore, the present investigation was under taken with the objective to study the effect of shade net intensities on growth and yield of coriander cultivars during summer season.

RESEARCH METHODS

The field experiment was conducted to study effect of different shading intensities on growth and yield of coriander cultivars at Horticulture Section, College of Agriculture, Kolhapur (Maharashtra) during summer 2015. The two cultivars such as JD-1 and local were cultivated in three shade net round type houses having 35, 50 and 75 per cent shading intensities and open field conditions also. The experiment was laid out in Factorial Completely Randomized Design with three replications. The soil inside the shade net was ploughed thoroughly, one month prior to sowing of seeds. The weeds and stubbles were removed completely and soil was brought to a fine tilth. Two days later, farm yard manure and fine sand were incorporated into the soil in proportion of 40 per cent river bed soil + 20 per cent sand + 40 per cent FYM and mixed uniformly and disinfected with 2 per cent formalin (20 ml per litre) by saturating the soil with application of diluted formalin @ 4 litres of solution per m^3. Immediately after treating the soil, the entire area was covered with black polythene sheet for 4 days and thereafter irrigated twice to remove chemical residue of formalin. The media was then leveled and the flat beds of 2.60 m width and 2.60 m length were prepared by keeping 15 cm row to row spacing in between the beds as working path. The required quantity of seeds *i.e.* 40 kg per hectare of coriander varieties *viz.*, JD-1 and local were made into halves by rubbing with hands before sowing and sown in the month of April, 2015. The first irrigation was given immediately after sowing and then at an interval of 3 to 4 days till harvesting. Two hand weeding were done after sowing. The proper sanitation was maintained within the shade net and plant protection measures were undertaken as and when required. The coriander crop was harvested separately at the stage of normal maturity 37 DAS (JD-1) and 40 DAS (Local). For recording various growth observations five plants were selected from each plot. The biometric observations such as days required for germination (DAS), days required for emergence of 3rd leaf (DAS), number of leaves, plant height (cm), length of leaves (cm) recorded at 15, 21, 28 DAS at an interval of 7 days till it harvest, number of branches per plant, internodal length (cm) and leaf area (cm^2) were recorded at 21, 28 DAS and at harvest. The yield parameters such as days required for harvesting, yield per plot (kg) and yield per hectare (q) were recorded.

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Growth parameters :

Days required for germination (*DAS*) :

The mean days required for germination recorded periodically crop growth which was significantly influenced due to 50 per cent shading intensity. Among the shading intensities, significantly minimum days required for germination were observed in 50 per cent shading intensity (8.00) as compared to open conditions (12.00) (Table 1). There may be some agro-climatic factors responsible for delayed germination and high temperature was found to be the limiting factor for the

germination and growth of coriander cultivars. The JD-1 variety required minimum number of days required for germination (8.79 days) compared to variety local (10.25).The interaction effect between shading intensities and variety on days required for germination was found to be non significant. The results of present findings are in close conformity with findings of Guha *et al*. (2013) in coriander crop.

Days required for emergence of 3rd leaf (*DAS*) :

The mean days required for emergence of 3rd leaf were as crop growth influenced significantly due to different shading intensities. Among the shading intensities, significantly minimum number of days required for emergence of 3rd leaf was observed in 50 per cent shading intensity (13.50) as compared to the remaining shading intensities. The JD-1 variety required minimum number of days for emergence of 3rd leaf (14.25 days) compared to variety local (15.92 days) (Table 1). This might be due to varietal character. The interaction effect between shading intensities and variety on days required for emergence of third leaf was found to be non significant. The results of present findings are in accordance with results reported by Guha *et al*. (2013) in coriander crop.

Number of leaves:

The number of leaves per plant was influenced significantly due to different shading intensities. Significantly more number of leaves per plant were recorded in 50 per cent shading intensity at all crop growth stages (3.17, 5.83, 9.25 and 21.92 at 15, 21, 28 DAS and at harvest, respectively) among all the shading intensities under study. The maximum number of leaves per plant in 50 per cent shading intensity might be attributed to the availability of more absorbed photosynthetical active radiation (APAR) resulting in to more photosynthetic rate and increased leaf number. The number of leaves per plant was influenced significantly due to different varieties at all growth stages. The variety JD-1 produced significantly higher number of leaves plant-1 (3.25, 5.21, 8.08 and 17.54 at 15, 21, 28 DAS and at harvest, respectively) as compared to local variety (Table 2). The variation in number of leaves between different varieties is attributed to inherent nature of genotypes. The interaction effect between shading intensities and variety on number of leaves per plant was found to be non significant. The results of present findings are in close conformity with findings of Guha *et al*. (2013) in coriander crop. These results are in conformity with the results obtained by Moniruzzaman *et al*. (2009) in Bangladhonia crop and Chatterjee and Mahanta (2013) in cauliflower.

Plant height (*cm*):

The mean plant height of plant increased

Table 1 : Effect of shading intensities and coriander varieties on days for germination and days for emergence of third leaf

Treatments	Days for germination	Days for required emergence of third leaf
Shading intensities		
S1-0%	12.00	17.67
S2-35%	9.33	15.0
S3- 50%	8.00	13.50
S4-75%	8.75	14.33
S.E.±	0.25	0.22
C.D. (P=0.05)	0.77	0.66
Varieties		
V_1- JD-1	8.79	14.25
V_2- Local	10.25	15.92
S.E.±	0.18	0.15
C.D. (P=0.05)	0.54	0.46
Interactions (S x V)		
S.E.±	0.36	0.31
C.D. (P=0.05)	NS	NS

NS= Non-significant

progressively with advancement of coriander growth. The plant height was influenced significantly due to different shading intensities. The significantly maximum plant height plant was recorded in 50 per cent shading intensity at all crop growth stages (3.88, 7.00, 13.33 and 19.17 cm at 15, 21, 28 DAS and at harvest, respectively) as compared with the open conditions. The maximum plant height in 50 per cent shading intensity plant grown in low light levels was found to be more apical dominance than those grown in high light environment resulting in taller plants under shade. The plant height was influenced significantly due to different varieties at all stages of crop growth stages. The variety JD-1 produced significantly maximum plant height (3.54, 6.17, 11.38 and 16.21 at 15, 21, 28 DAS and at harvest, respectively) as compared to local variety (Table 2). This may be attributed to their genetic potential and adaptability to microclimatic conditions under shade net. The interaction effect between shading intensities and variety on plant height was found to be non significant. Similar results were reported by Moniruzzaman *et al*. (2009) in Bangladhonia, Thangam and Thamburaj (2008) in tomato, Chatterjee and Mahanta (2013) in cauliflower and Araki *et al*. (1999) in spinach.

Number of branches :

The number of branches per plant was influenced significantly due to different shading intensities. The significantly maximum number of branches per plant was recorded in 50 per cent shading intensity at all crop growth stages (3.47, 5.07, and 6.17 at 21, 28 DAS and at harvest, respectively) which were at par with 75 per cent shading intensities at 21 DAS and at harvest. Significantly minimum number of branches per plant was noticed under open conditions during at all crop growth stages (1.67, 2.07 and 3.33 at 21, 28 DAS and at harvest, respectively). The number of branches per plant was influenced significantly due to different varieties at all stages of crop growth stages. The variety JD-1 produced significantly maximum number of branches per plant (2.94, 4.15 and 5.42 at 21, 28 DAS and at harvest, respectively) as compared to local variety (Table 3). This might be due to growth habit of varieties and its adjustment with the prevailing microclimatic condition of the shade net. The interaction effect between shading intensities and variety on number of branches per plant was found to be non-significant. These results are in agreement with those reported by Dixit (2007) in different vegetables and Thangam and Thamburaj (2008) in tomato.

Internodal length (*cm*) :

The internodal length plant was influenced significantly due to different shading intensities. The

Table 2 : Effect of shading intensities and varieties of coriander on number of leaves per plant, plant height and length of leaves

Treatments	No. of leaves/plant				Plant height (cm)				Length of leaves			
	15 DAS	21 DAS	28 DAS	At harvest	15 DAS	21 DAS	28 DAS	At harvest	15 DAS	21 DAS	28 DAS	At harvest
Shading intensities												
S1-0%	2.17	3.60	4.92	9.17	2.48	3.40	6,33	8.92	1.95	2.33	2.58	3.05
S2-35%	2.67	4.50	7.50	16.88	2.98	5.87	10 50	15.33	2.10	2.83	3.17	3.97
S3- 50%	3.17	5.83	9.25	21. 92	3.88	7.00	13.33	19.17	2.33	3.58	3.98	4.58
S4-75%	3.00	5.00	8.07	18.53	3.47	6.35	12.08	17,25	2.20	3.17	3.67	4.17
S.E.±	0.18	.23	0.33	0.56	0.16	0.27	0.26	0.37	0.06	0.15	0.15	0.13
C.D. (P=0.05)	0.55	0.71	0.99	1.70	0.48	0.81	0.79	1.11	0.19	0.45	0.45	0.39
Varieties												
V_1- JD-1	3.25	5.21	8.08	17.54	3.54	6.17	11.38	16.21	2.29	3.25	3.58	4.14
V_2- Local	2.25	4.26	6.78	15.71	2.82	5.14	9.75	14.13	2.10	2.71	3.12	3.74
S.E.±	0.13	0.16	0.23	0.40	0.11	0.19	0.18	0.26	0.04	0.10	0.10	0.09
C.D. (P=0.05)	0.39	0.50	0.70	1.20	0.34	0.57	0.56	0.79	0.14	0.31	0.32	0.27
Interactions (S x V)												
S.E.±	0.26	0.33	0.46	0.80	0.22	0.38	0.37	0.52	0.09	0.21	0.21	0.18
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS= Non-significant

significantly maximum internodal length was recorded in 50 per cent shading intensity at all crop growth stages (2.20, 3.20 and 6.08 cm at 21, 28 DAS and at harvest, respectively) which was at par with 75 per cent shading intensities at harvest. The minimum internodal length were noticed under open conditions during at all crop growth stages (1.85, 2.32 and 3.48 cm at 21, 28 DAS and at harvest, respectively). The maximum intermodal length plant^{-1} in 50 per cent shading intensities plant exhibited the longest internode at 50 per cent photosynthetical active radiation (PAR) level was obtained under full sunlight upto 50 per cent reduced sunlight.The internodal length was influenced significantly due to different varieties at all stages of crop growth stages. The variety JD-1 produced significantly maximum internodal length (2.15, 3.00 and 5.49 cm at 21, 28 DAS and at harvest, respectively) as compared to local variety (Table 3). This might be due to growth habit of varieties and its adjustment with the prevailing microclimatic conditions of the shade net. The interaction effect between shading intensities and variety on intermodal length was found to be non-significant. The results of present findings are in close conformity with the findings reported by Haque *et al*. (2009) in bottle gourd crop.

Length of leaves (*cm*) :

The length of leaves increased progressively with advancement of crop growth. The length of leaves per plant was influenced significantly due to different shading intensities. Significantly maximum length of leaves were recorded in 50 per cent shading intensity at all crop growth stages (2.33, 3.58, 3.98 and 4.58 cm at 15, 21, 28 DAS and at harvest, respectively) which was at par with 75 per cent shading intensities at 15, 21, 28 DAS and at harvest. Significantly the minimum length of leaves per plant was noticed under open conditions at all crop growth stages (1.95, 2.33, 2.58 and 3.05 cm at 15, 21, 28 DAS and at harvest, respectively). The length of leaves was influenced significantly due to different varieties at all stages of crop growth stages. The variety JD-1 produced significantly maximum length of leaves plant^{-1} (2.29, 3.25, 3.58 and 4.14 cm at 15, 21, 28 DAS and at harvest, respectively) as compared to local variety (Table 2). The interaction effect between shading intensities and variety on length of leaves of coriander was found to be non-significant. These findings are in conformity with the result of Dixit (2007) in different vegetables and Moniruzzaman *et al*. (2009) in Bangladhonia.

Leaf area (*cm^2*) :

The leaf area per plant increased progressively with advancement of crop growth. The leaf area per plant was influenced significantly due to different shading intensities. Significantly maximum leaf area per plant was recorded in 50 per cent shading intensity at all crop growth stages (3.96, 4.33, 4.67 cm^2 at 21, 28 DAS and at harvest,

Table 3 : Effect of shading intensities and varieties of coriander on number of branches per plant, intermodal length and leaf area (cm^2)

Treatments	No. of branches/plant			Internodal length (cm.)			Leaf area (cm^2)		
	21 DAS	28 DAS	At harvest	21 DAS	28 DAS	At harvest	21 DAS	28 DAS	At harvest
Shading intensities									
S1-0%	1.67	2.07	3.33	1.85	2.32	3.48	2.63	3.13	3.50
S2-35%	2.67	4.03	5.00	1.95	2.78	5.20	3.08	3.63	4.01
S3- 50%	3.47	5.07	6.17	2.20	3.20	6.08	3.96	4.33	4.67
S4-75%	3.07	4.67	5.67	2.03	2.93	5.70	3.54	3.96	4.25
S.E.±	0.12	0.12	0.18	0.05	0.07	0.19	0.15	0.14	0.17
C.D. (P=0.05)	0.36	0.37	0.55	015	0.22	0.58	0.46	0.42	0.51
Varieties									
V_1-JD-1	2.94	4.15	5.42	2.15	3.00	5.49	3.54	4.05	4.40
V_2- Local	2.48	3.77	4.67	1.87	2.63	4.74	3.06	3.48	3.81
S.E.±	0.08	0.08	0.13	0.03	0.05	0.13	0.11	0.10	0.12
C.D. (P=0.05)	0.26	0.25	0.39	0.11	0.16	0.41	0.33	0.30	0.36
Interactions (S x V)									
S.E.±	0.17	0.12	0.26	0.07	0.10	0.27	0.22	0.20	0.24
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS= Non-significant

respectively) which was at par with 75 per cent shading intensities 21 and 28 DAS and at harvest. Significantly the minimum leaf area per plant was noticed under open conditions during at all crop growth stages (2.63, 3.13 and 3.50 cm^2 at 21, 28 DAS and at harvest, respectively). The leaf area per plant was influenced significantly due to different varieties at all stages of crop growth stages. The variety JD-1 produced significantly maximum leaf area $plant^{-1}$ (3.54, 4.05 and 4.40 cm^2 at 21, 28 DAS and at harvest, respectively) as compared to local variety (Table 3). The interaction effect between shading intensities and variety on leaf area of coriander was found to be non- significant. These results are similar to those reported by Moniruzzaman *et al*. (2009) in Bangladhonia and Kittas *et al*.(2009) in tomato.

Yield and yield contributing characters :

Days required for harvesting :

In the present investigation, the days required for harvesting of the coriander was found to be significantly influenced due to 50 per cent shading intensities as compared to open conditions. Among the shading intensities, significantly minimum days required for harvesting were observed in 50 per cent shading intensity (36.67) whereas significantly maximum days required for harvesting were observed under open conditions (42.17) (Table 4). The JD-1 variety required minimum number of days required for harvesting (37.33) compared to variety local (40.08) which might be due to differences in growth habit of the varieties. The interaction effect between shading intensities and variety on days required for first harvesting was found to be non-significant. The results of present findings are in close conformity with results of obtained by Thangam and Thamburaj (2008) in tomato.

Yield per plot (*kg*):

The yield of coriander was found to be influenced significantly due to different shading intensities. The highest yield per plot was recorded in treatment 50 per cent shading intensity (3.40 kg) whereas the lowest yield per plot was recorded in open conditions (0.77 kg). Among the varieties, variety JD-1 produced significantly maximum yield per plot (2.53 kg) and minimum yield per plot (2.02 kg) local variety. The interaction effect between shading intensities and variety on yield per plot was found to be non-significant. Similar results were reported by Tehlan and Malik (2010) in coriander.

Yield per hectare (*q*) :

The yield of coriander was found to be influenced significantly, due to different shading intensities. The highest yield was noticed in 50 per cent shading intensity (50.23 q per ha) whereas the lowest yield was recorded in control (11.35 q per ha). This might be due to number of leaves resulted in highest yield. Increased the green

Table 4 : Effect of shading intensities and varieties of coriander on days required for first harvesting, yield per plot and yield per hectare

Treatments	Days to first harvesting	Yield per plot (kg)	Yield per ha. (q)
Shading intensities			
S1-0%	42.17	0.77	11.35
S2-35%	39.16	2.20	32.52
S3- 50%	36.67	3.40	50.23
S4-75%	37.83	2.73	40.43
S.E.±	0.81	0.09	1.45
C.D. (P=0.05)	2.43	0.29	4.36
Varieties			
V_1-JD-1	37.33	2.53	37.44
V_2- Local	40.08	2.02	29.82
S.E.±	0.57	0.06	1.03
C.D. (P=0.05)	1.77	0.20	3.08
Interactions (S x V)			
S.E.±	1.14	0.13	2.06
C.D. (P=0.05)	NS	NS	NS

NS= Non-significant

leaves yield may be due to excellent leaf growth 50 per cent shading intensity. Among the varieties, variety JD-1 produced significantly maximum yield ha^{-1} (37.44 q per ha) while the minimum yield (29.82 q per ha) local variety (Table 4). This might be due to the fact that the coriander cultivars are grown generally in winter, if it is grown in summer with protected conditions the yield was found to be more. The favourable microclimatic conditions developed in shade net house cause better growth of coriander and ultimately resulted in higher yield. The interaction effect between shading intensities and variety on yield per ha was found to be non-significant. The results of present findings are in close conformity with findings of Tehlan and Malik (2010) in coriander.

Conclusion:

Form the present findings it is concluded that, the 50 per cent shading intensities was found to suitable for cultivation of JD-1 cultivars as compared with remaining shading intensities over local cultivar which exhibited better growth and yield performance.

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