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Evaluation of Yield Contributing Traits in Coriander (*Coriandrum sativum* L.) Varieties under Drought Conditions

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ABSTRACT

Background: Coriander (*Coriandrum sativum* L.) also called 'Dhania' (Hindi), belongs to Apiaceae family is an important seed spice, tall herbaceous annual diploid (2n=22) crop grown around the world for its fruits as well as for tender green leaves.

Methods: The present investigation was done to assess the genetic variations among coriander genotypes for drought stress. Eight Coriander varieties *viz.* Rcr-20, Rcr-41, Rcr-435, Rcr-436, Rcr-446, Rcr-475, Rcr-684 and Rcr-728 were evaluated in randomized block design with three replications at the research farm of S.K.N. College of Agriculture, Jobner (Rajasthan) during *Rabi*, 2016. The plot was irrigated at regular interval in control condition while in drought condition plots were maintained under rainfed condition. The various morpho-physiological or yield and yield contributing parameters were recorded at maturity stages and after harvesting. The mean performance of the genotypes was decreased under drought stress in comparison to control condition for all parameters.

Result: The coriander varieties Rcr-446 and Rcr-20 were found to be drought tolerant varieties with less effect of water stress on yield contributing traits. While, coriander varieties Rcr-435 and Rcr-728 maintained higher seed yield along with number of umbels per plant, seeds per umbel, test weight, seed yield, biological yield, harvest index under control conditions. Thus, these varieties may be used as drought tolerant varieties for further investigation.

Key words: Coriander, Drought, Rcr, Seed yield, Variation.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) also called 'Dhania' (Hindi) is an important seed spice, tall herbaceous annual diploid (2n=22) crop grown around the world for its fruits as well as for tender green leaves which belongs to the family Apiaceae. It is highly cross pollinated crop believed to be native of Mediterranean region. Its inflorescence is a compound umbel with purple or white flowers. The coriander leaves and seeds have a pleasant odour that used for preparation of chutneys and pickles. It is also used as a spice in culinary (Diederichsen, 1996), medicine (Kubo *et al.,* 2004). It is also used in folk medicine as appetizer, tonic, carminative and diuretic (Cornara *et al*., 2009). The dry seed contains 6.3% moisture, 1.3% protein, 0.3-0.4% volatile oil, 19.6% nonvolatile oil, 24.6% carbohydrates and 5.3% mineral matter that is considered to be carminative, diuretic, stomatic tonic, antibilious, refrigerant and aphrodisiac (Murty and Sridhar, 2001). The coriander fruits have aromatic odour and taste due to presence of essential oil called "coriandrol" (Kumawat *et al*., 2017). In Rajasthan it is mainly grown in the district of baran, kota, bundi, chittorgarh and Jhalawar with an area of 212725 ha and annual production of 227203 tones (Anonymous, 2015-2016). Drought is a meteorological term and is commonly defined as a period without significant rainfall. It is one of the most universal and significant environmental stress affecting plant growth and productivity worldwide. Therefore, understanding crop response to this stress is very important. There are significant differences in the tolerance of plants to drought stress depending upon intensity and duration of stress, plant species and the development stage. Drought impacts include growth, yield, membrane integrity, pigment content, osmotic adjustment, water relations and photosynthetic activity (Benjamin and Nielsen, 2006; Praba *et al*., 2009). The starting point in any breeding programme is the collection of large germplasm to identify genetic variability present in the germplasm that forms the basis for crop improvement. The adequacy of the genotypes is determined by the amount of genetic variability present in the germplasm and information on nature and magnitude of variability for different important characters to judge the potentiality of the germplasm collection. In present investigation efforts have been made to identify drought

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tolerance mechanism in susceptible/ tolerance varieties of Coriander.

MATERIALS AND METHODS

The experiment was conducted on field No. 8 at Research Farm, S.K.N. College of Agriculture, Jobner. Geographically, Jobner is situated 45 km west of Jaipur at 26° 05′ North latitude, 75° 28′ East longitude and at an altitude of 427 meters above mean sea level. The area fall in agro climatic zone-IIIA (Semi-arid Eastern Plain Zone) of Rajasthan. The study was conducted in randomized block design with three replications using eight genotypes of coriander namely Rcr-20, Rcr-446 (drought tolerant) and Rcr-41, Rcr-435, Rcr-436, Rcr-475, Rcr-684 and Rcr-728 (drought susceptible). The soil of the experimental field was loamy sand in texture and alkaline in reaction. These varieties were grown in the field under standard package of practices in control and drought condition. Under control condition, the plants were irrigated at flowering and seed formation stage while in drought; the plants were maintained under rainfed condition. Observation was taken on various morpho-physiological or yield contributing traits in both the conditions between 10 A.M. to 12 noon. Observation on 50% flowering was taken when half of the plants in a plot flowered. Plant height, number of umbel per plant, seeds per umbel and umbellates per umbel were measured at time of harvesting, whereas, test weight, seed yield, harvest index, biological yield and drought susceptibility index were measured after harvesting and threshing of the crop. All these parameters helped in assessing tolerant versus susceptible genotypes at physiological levels between the two critical stages of development to water stress.

The drought susceptibility index (DSI) was calculated according to Fisher and Maing to Fisher and Maurer (1978) for each genotype.

$$DSI = \frac{[1-(Y_s/Y_p)]}{[1-(\bar{Y}_s/\bar{Y}_p)]}$$

Where,

Y_s = Yield of cultivar under stress.

Y_p = Yield of cultivar under irrigated condition.

$\bar{Y}_s$ = Mean yield of cultivar under stress.

$\bar{Y}_p$ = Mean yield of cultivar under irrigated condition.

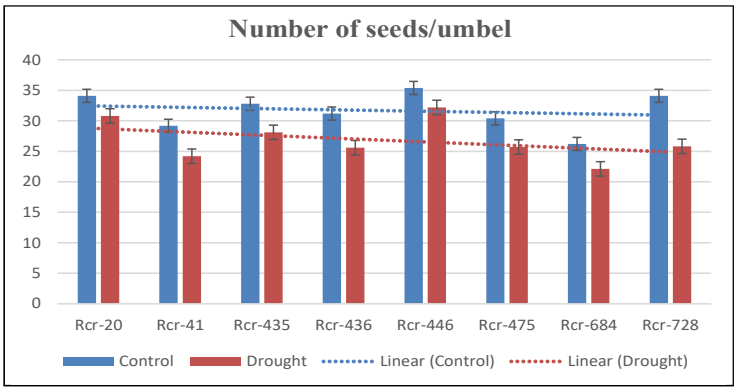
RESULTS AND DISCUSSION

Water stress is the major environmental stress, which limit the growth and productivity of crop in arid and semi-arid regions (Osmond *et al*., 1980). A reduction due to drought stress was noted in morpho-physiological or yield and yield contributing parameters (Table 1 and Fig 1). However, the degree of reduction or increase varied significantly among the different varieties of coriander. Tolerant genotypes try to maintain the physiological process by maintaining the water status either by reducing the water losses or by increasing the absorption of water (Larcher, 2004). The days to 50%

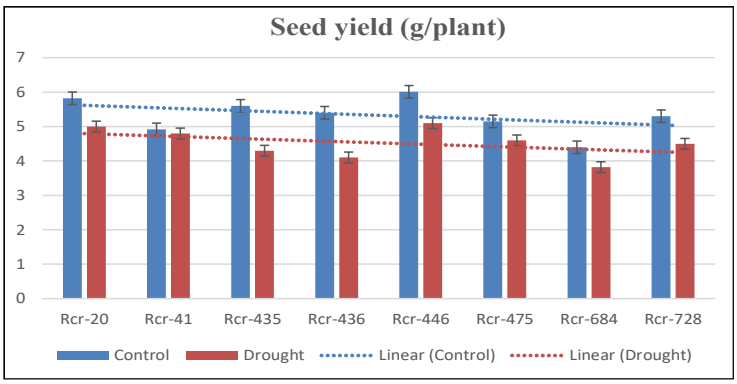
Table 1: Variations in different morpho-physiological or yield and yield contributing parameters among coriander varieties under drought conditions.

Varieties	Days to 50% flowering			Plant height (cm)			Number of umbels per plant			Number of seeds per umbel			Number of umbellates per umbel			Test weight (g)			Seed yield (g)			Biological yield (g)			Harvest index (%)			DSI
	I_0	I_1		I_0	I_1		I_0	I_1		I_0	I_1		I_0	I_1		I_0	I_1		I_0	I_1		I_0	I_1		I_0	I_1		
Rcr-20	61.80	52.51		64.10	60.20		35.20	31.50		34.10	30.80		5.15	4.10		13.30	12.08		5.82	5.00		13.43	12.45		45.05	37.59		0.38
Rcr-41	65.60	53.52		63.00	61.30		32.91	28.82		29.20	24.20		4.70	3.90		11.30	11.10		4.92	4.80		12.65	11.20		42.86	38.89		1.01
Rcr-435	58.50	55.95		69.50	58.60		35.60	30.52		32.80	28.10		4.80	3.85		12.10	11.98		5.60	4.30		12.90	11.75		43.41	36.60		1.55
Rcr-436	62.30	57.91		65.60	59.20		34.10	32.80		31.20	25.60		4.60	3.90		12.30	12.06		5.40	4.10		12.55	11.60		43.03	35.34		1.61
Rcr-446	68.21	54.38		69.20	60.00		43.60	35.53		35.40	32.20		5.30	4.15		13.50	12.78		6.01	5.10		13.20	12.00		45.53	42.50		0.16
Rcr-475	61.32	55.87		64.10	57.00		32.60	27.92		30.40	25.70		4.50	3.60		12.58	11.20		5.15	4.60		13.10	12.05		39.31	38.17		0.71
Rcr-684	63.52	55.61		70.30	58.90		39.80	25.88		26.20	22.10		3.90	3.15		13.40	11.65		4.40	3.82		12.70	12.55		32.76	30.68		0.88
Rcr-728	69.20	64.35		72.00	54.50		38.20	32.25		34.10	25.80		4.25	4.10		12.10	11.60		5.30	4.50		12.92	11.97		41.73	39.84		1.51
Mean	63.81	56.26		67.23	58.71		36.50	30.65		31.68	26.81		4.65	3.84		12.57	11.81		5.33	4.53		12.93	11.95		41.21	37.95		-
	Sem ±	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		**Sem ±**	**CD**		
Variety(V)	1.08	3.12		1.65	4.76		0.94	2.71		0.80	2.30		0.107	0.309		0.37	1.06		0.16	0.47		0.36	1.03		0.46	1.33		0.010
Stress (S)	0.54	1.56		0.82	2.38		0.47	1.36		0.40	1.15		0.054	0.155		0.18	0.53		0.08	0.23		0.18	0.51		0.23	0.67		0.031
V × S	1.53	4.41		2.33	6.74		1.33	3.83		1.13	3.26		0.151	0.437		0.52	NS		0.23	0.66		0.50	1.45		0.65	1.88		-
Mean reduction (%)	11.83			12.67	16.03		15.37	17.42		6.05	15.00		7.58	7.91		-												

I_0 = Control condition; I_1 = Drought condition; CD @ p=0.05; DSI = Drought susceptibility index.



(A)



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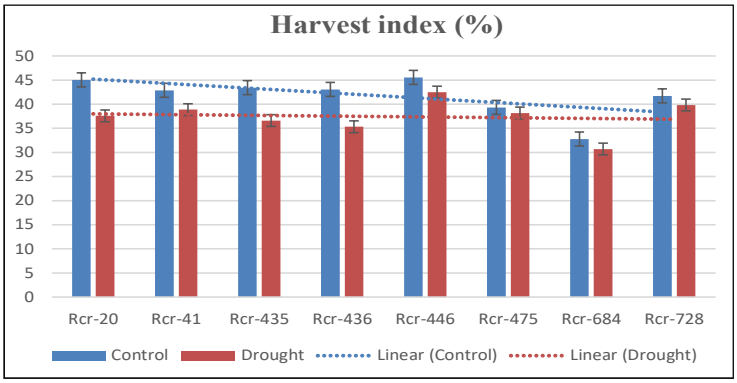

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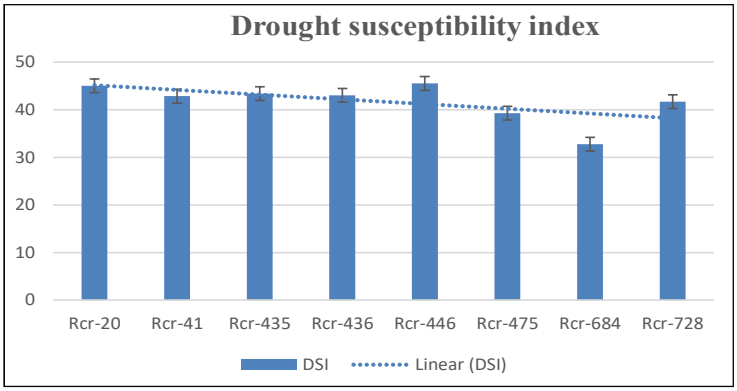

(D)

Fig 1: Graphical representation of variation in different parameters among coriander varieties under control and drought conditions, (A) No. of seeds per umbel; (B) Seed yield (g/plant); (C) Harvest Index and (D) Drought susceptibility index.

flowering was noted earlier under drought condition than control condition. The varieties varied significantly for days to 50% flowering under stress and the mean reduction was 11.83%. This reduction indicates that drought condition caused some metabolic changes in the coriander plants conversion from vegetative phase to reproductive phase. Water stress decreased number of pods per plant at 50% flowering stage in chickpea (Hamid *et al.,* 1990). Plant height varied significantly among the varieties under control as well as drought conditions with mean reduction under drought condition was 12.67%. Singh and Choudhary (2003) reported that mean performance of genotypes for plant height was comparatively low under stress condition and reported 15.70% reduction due to stress for plant height. Similarly, number of umbels per plant, seeds per umbel, umbellates per umbel and test weight was decreased by 16.03%, 15.37%, 17.42% and 6.05% respectively under drought condition (Table 1 and Fig 1).

Result on seed yield indicated that Rcr-446 exhibited maximum yield under control condition which was closely followed by Rcr-20 and Rcr-435. In contrast Rcr-446 exhibited maximum yield under drought condition which was closely followed by Rcr-20 and Rcr-41. The seed yield was decreased by 15.00% under drought condition (Table 1). These variations in yield were found attribute to the variations in yield contributing parameters vis-a-vis existence of drought tolerance mechanism at cellular and molecular level (Duwal *et al.,* 2019). In present investigation the highest yield of Rcr-446 under drought condition might be on account of better performance of this variety to yield contributing parameters like umbels per plant, seeds per umbel, umbellates per umbel, test weight, biological yield and harvest index (Giridhar *et al.,* 2014; Duwal *et al.,* 2019).

Water stress caused decrease in biological yield as compared to non stress condition. Biological yield is an important criterion for improvement in yield, which is strongly influenced by the environment (Kumar *et al.,* 2001). The biological yield and harvest index was decreased by 7.58% and 7.91% in drought condition. Drought susceptibility of a genotype is often measured as a function of the reduction in yield under drought stress (Blum, 1988). The lowest DSI value was found in variety Rcr-446 (0.16) followed by Rcr-20 (0.38) and Rcr-475 (0.71) indicated tolerance towards drought stress (Table 1).

CONCLUSION

In the present study, there is reduction in yield due to water stress at both the stages. The decrease was more in seed formation as compared to flowering in water stress. The coriander varieties Rcr-20 and Rcr-446 showed as drought tolerant varieties maintained higher seed yield along with number of umbels per plant, seeds per umbel, umbellates per umbel, test weight, seed yield, harvest index and biological yield under drought condition. All these traits of the varieties helped them to maintain lower drought susceptibility index and tolerate the drought condition. While, coriander varieties Rcr-435 and Rcr-728 maintained higher seed yield along with number of umbels per plant, seeds per umbel, test weight, seed yield, biological yield, harvest index under control conditions. Thus it can be concluded that, an extensive water stress tolerance mechanism is active in coriander crop for both the stages.

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Conflict of interest

All authors declared that there is no conflict of interest.

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