Journal of Spices and Aromatic Crops
Vol. 19 (1 & 2) : 53–56 (2010)

Indian Society for Spices

Effect of water stress on seed quality of coriander (*Coriandrum sativum* L.)

S N Saxena, R K Kakani, R Saxena & M M Anwer

National Research Centre on Seed Spices
Tabiji, Ajmer-305206, Rajasthan, India.
Email: shail.saxena@rediffmail.com

Received 1 June 2010; Revised 7 August 2010; Accepted 26 August 2010

Abstract

Twelve coriander (*Coriandrum sativum*) accessions comprising of released varieties, advanced breeding material, regional and exotic collections were evaluated at Ajmer (Rajasthan) for effect of water stress on seed quality parameters including total oil, essential oil, test weight and seed size. All the recorded parameters showed significant genotypic variation as well as significant interaction of genotype with environment. Mid-term water stress did not have adverse effect on the studied quality parameters while terminal water stress resulted in reduction in quality parameters in most of the accessions.

Keywords: *Coriandrum sativum*, coriander, essential oil, stress.

Limited water supply is a major environmental constraint for higher productivity of crop plants including coriander (*Coriandrum sativum* L.). Moisture deficiency induces various physiological and metabolic processes and the adaptability and responses of the plant to water stress depends on duration, magnitude of stress and developmental and differentiation stage of the plant/tissue (Kramer & Boyer 1995). Genotypic variability to stress has been reported in various plants and this variability can be exploited for development of drought tolerant varieties. There are some reports on the effect of water stress on essential oil content of some medicinal and aromatic plants (Burbott & Loomis 1969; Solinas & Deiana 1996; Sabih *et al.* 1999). In India, the major coriander growing area lies under semi-arid climate of Rajasthan and Gujarat where the crop is cultivated on conserved moisture during *rabi* season requiring two to three irrigations depending upon soil conditions and rainfall. Hence, the available water has to be used very precisely so that maximum yield can be recovered without affecting the quality of seeds. The present investigation was undertaken to evaluate the genotypic variation in response to water stress and its effect on seed quality parameters of coriander. The results of the study will also help growers to decide time of irrigation for coriander when water availability is limited.

Seeds of 12 accessions of coriander comprising of released varieties, advanced breeding material, regional and exotic collections were evaluated at National Research Centre on Seed Spices, Ajmer (Rajasthan) during 2009-10. Three irrigation schedules namely, irrigated, water stress at mid-season growth and water stress at terminal growth stage were created. All 12 accessions were sown with three replications in a randomized block design. The data were analyzed for genotypic variation, environment effect and interaction effect of genotype and environment using factorial randomized block design (Panse & Sukhatme 1967). Under irrigated schedule, irrigation was given as and when required. In mid-term water stress schedule, irrigation was withheld at flowering stage. In terminal water stress, the last irrigation was withheld. Except irrigation, all other agronomic practices including pest and disease management were followed uniformly up to harvest in all three schedules. Test weight was measured as 1000 seed weight and size of seeds was measured using screw gauge. Total oil was extracted using Accelerated Solvent Extraction System (Dionex India Pvt. Ltd.); 30 g seeds of each accession obtained from different irrigation schedules were utilized for the estimation. Essential oil from seeds was estimated using all glass Clevenger apparatus (Clevenger 1928), utilizing 25-30 g seed samples from various treatments.

Under non-stress or control condition, essential oil content ranged from 0.01% (YS/RC 41) to 0.51% (LCC 101) exhibiting high genotypic variation. Total oil content varied from 9.25% in YS/RC 41 to 16.59% in ACr 91. Test weight also showed genotypic variation, ranging from 9.45 g in ACr 1 to 23.48 g in LCC 101. Seed size also significantly varied with the genotypes. Under non-stress condition seed size ranged from 3.11 mm (ACr 1) to 4.38 mm (LCC 101). Interaction of genotypes with stress was also evident in seed size (Table 1).

In most of the accessions from mid-term stress condition, the essential oil content was reduced to a minimum of 0.11% in YS/RC 41 to a maximum of 0.29% in RCr 435. The accessions ACr 256, Australlia, Sindhu and YS/RC 41 however, showed significant increase over control in essential oil content. Total oil content was minimum (7.8%) in ACr 256 and maximum (21.14%) in LCC 101. Total oil content was either at par with control or reduced in most of the accessions except LCC 101 and NDCOR 60 where significant increase over control in total oil content was recorded (Table 1).

In the accessions where the last irrigation was withheld (terminal water stress) essential oil content in some accessions like ACr 1, Australia, NDCOR 60, RCr 41, Sindhu and YS/RC 41 showed significant increase over control while accessions ACr 91, LCC 101, LCC 91, RCr 435 and RCr 436 exhibited slight decrease in essential oil content. However, when compared with mid-term stress conditions, accessions LCC 101, LCC 91 and NDCOR 60 showed significant increase in essential oil content. Total oil content from these accessions was reduced as compared to non-stress as well as mid-term stress condition except in accession YS/RC 41 where a significant increase over control was observed. Accessions Australia, LCC 101, LCC 91 and NDCOR 60 showed significant reduction over control and midterm stress in total oil content (Table 1).

It is well known that genetic constitution and environmental conditions influence the yield and composition of volatile oil produced by medicinal plants (Ramezani *et al.* 2009). Drought stress increases the essential oil percentage in medicinal and aromatic plants, because in case of stress, more metabolites are produced in plants. Farahani *et al.* (2008) reported that drought stress had significant effect on oil yield and oil percentage of calendula. Their results showed that highest oil yield was achieved under non-drought condition and highest oil percentage was achieved under drought condition. Aliabadi *et al.* (2008) reported that water stress had significant effect on flowering, shoot yield and essential oil yield of flowering shoot of coriander.

In the present investigation, significant variation in response of different accessions on imposing water stress on essential oil and total oil content was observed. A significant

Table 1. Effect of water stress on quality of seeds in coriander accessions

Accession	Total oil (%)				Essential oil (%)				Test weight (g)				Seed size (mm)			
	Non-Stress/ Control	Mid-term water stress	Terminal water stress	Mean	Non-Stress/ Control	Mid-term water stress	Terminal water stress	Mean	Non-Stress/ Control	Mid-term water stress	Terminal water stress	Mean	Non-Stress/ Control	Mid-term water stress	Terminal water stress	Mean
ACr 1	13.25	14.93	13.08	13.75	0.19	0.23	0.22	0.21	9.45	14.11	10.18	11.24	3.11	3.23	3.06	3.13
ACr 91	16.59	16.55	9.90	14.35	0.21	0.19	0.19	0.20	16.18	14.49	14.01	14.89	3.24	3.87	3.35	3.49
ACr256	10.59	7.80	9.24	9.21	0.09	0.21	0.09	0.13	9.68	13.88	11.47	11.68	3.14	3.33	3.30	3.26
Australlia	15.98	15.81	12.48	14.76	0.15	0.21	0.20	0.19	16.82	18.42	15.85	17.03	3.47	3.36	3.95	3.59
LCC 101	15.43	21.14	10.74	15.77	0.51	0.26	0.41	0.39	23.48	23.35	20.84	22.56	4.38	4.37	4.61	4.45
LCC 91	14.26	14.20	11.06	13.17	0.39	0.23	0.33	0.32	21.83	21.71	22.67	22.07	4.25	4.20	4.08	4.18
NDCOR 60	15.24	18.11	12.25	15.20	0.32	0.25	0.43	0.33	22.33	23.23	21.14	22.23	4.34	4.19	3.94	4.16
RCr 41	16.27	15.15	14.38	15.27	0.02	0.14	0.19	0.12	15.68	13.66	12.01	13.78	3.24	3.21	3.30	3.25
RCr 435	13.44	12.29	12.09	12.61	0.30	0.29	0.27	0.29	15.09	13.69	13.28	14.02	3.35	4.59	3.51	3.82
RCr 436	16.17	16.74	14.85	15.92	0.19	0.17	0.16	0.14	16.59	23.13	17.19	18.97	3.33	3.40	3.94	3.56
Sindhu	13.95	11.30	11.30	12.18	0.11	0.19	0.15	0.15	16.67	14.67	16.00	15.78	3.44	3.30	3.16	3.30
YS/RC 41	9.25	8.80	14.23	10.76	0.01	0.11	0.13	0.08	15.68	9.23	9.61	11.50	3.60	3.46	3.14	3.40
SEm (±)	0.59	0.59	0.52	1.15	0.01	0.01	0.01	0.03	0.71	0.72	0.67	0.98	0.15	0.15	0.15	0.14
CD (P=0.05)	1.72	1.74	1.51	3.335	0.03	0.02	2.11	0.101	1.51	0.03	1.95	2.83	0.44	0.45	0.44	0.420
Mean (Stress)	14.20	14.40	12.13	13.58	0.21	0.20	0.23	0.21	16.62	16.96	15.35	16.31	3.57	3.71	3.61	3.63
SEm (±)		0.58				0.02				0.49				0.07		
CD (P=0.05)		3.33				0.10				2.83				0.42		
SEM (A x S)		0.61				0.01				0.75				0.16		
CD (A x S)		1.73				0.03				2.13				0.46		
CV (%)		7.78				8.59				7.99				7.71		

Interaction: A = Accession; S = Stress

interaction effect of accessions and different stress conditions revealed that genotypes could be identified for a particular environment. Mid-term water stress did not have adverse effect on essential oil, total oil, seed size and test weight in most of the accessions; however, terminal water stress exhibited reduction in the studied quality parameters in most of the accessions. It may be suggested that in a situation of limited water, mid-term irrigation can be avoided and must be applied at terminal growth stage.

References

Aliabadi F H, Lebaschi M H & Hamidi A 2008 Effects of arbuscular mycorrhizal fungi, phosphorus and water stress on quantity and quality characteristics of coriander. J. Adv. Nat. Appl. Sci. 2 (2): 55-59.

Burbott A J & Loomis D 1969 Evidence for metablic turnover of monoterpene in peppermint. Plant Physiol. 44: 173-179.

Clevenger J F 1928 Apparatus for determination of essential oil. J. Am. Pharm. Assoc. 17: 346-349.

Farahani H A, Valadabadi A & Rahmani N 2008 Effects of nitrogen on oil yield and its component of Calendula (*Calendula officinalis* L.) in drought stress conditions. Abstracts, The World Congress on Medicinal and Aromatic Plants (p. 364) Cape Town, South Africa. November 2008.

Kramer P J & Boyer J S 1995 Water Relations of Plants and Soils. Academic Press, San Diego.

Panse V G & Sukhatme P V 1967 Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi.

Ramezani S, Ramezani F, Rasouli F, Ghasemi M & Fotokian M H 2009 Diurnal variation of the essential oil of four medicinal plants species in central region of Iran. Res. J. Biol. Sci. 4: 103-106.

Sabih F, Abad Farooki A H, Ansari S R, & Sharama S 1999 Effect of water stress on growth and essential oil metabolism in *Cymbopogon martinii* (Palmrosa) cultivars. J. Essential Oil Res. 1: 151-157.

Solinas V & Deiana S 1996 Effect of water and nutritional conditions on the *Rosmarinus officinalis* L., phenolic fraction and essential oil yields. Riv. Ital. Eposs. 19: 189-198.