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Influence of stress mitigating chemicals on growth, yield parameters and quality of coriander (*Coriandrum sativum* L.)

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Abstract
A field experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Jaipur) during *rabi* season 2016-17 to study the effect of stress mitigating chemicals on coriander varieties (*Coriandrum sativum* L.) grown on irrigated loamy sand soil of semi-arid eastern plain zone of Rajasthan. The experiment consisting of four varieties (RCr-435, RCr-728, RCr-436 and RCr-41) and six stress mitigating chemicals (water sprayed control, salicylic acid @ 100 ppm, thiourea @ 500 ppm, kinetin @ 30 ppm, DMSO @ 78g/ha and TGA @ 100 ppm at 40 and 60 DAS) making 24 treatment combinations were replicated three times in randomized block design. The results indicated that highest values of growth, yield attributing parameters, grain (14.82q/ha) and stover yield (42.03 q/ha) were obtained with variety RCr-728. Among different PGRs applied, foliar spray of 500 ppm thiourea, being at par with salicylic acid, was found most effective and significantly increased the growth parameters viz., plant height, branches/plant, dry matter accumulation/metre row length, yield attributes (umbels/plant, umbellets/umbel and seeds/umbel), seed (15.19 q/ha), straw (42.22 q/ha) and biological yields (57.41 q/ha), protein and essential oil content in seed as compared to other stress mitigating chemicals.

Keywords: growth, yield parameters, quality, stress mitigating chemicals and coriander

Introduction
Coriander (*Coriandrum sativum* L.) is an important seed spice crop grown in our country with 0.66 mha area and 0.61 mt production (Press information bureau, 2017) [9] for its fruits as well as tender green leaves. The leaves and fruits of coriander have pleasant odour used for chutney, sauces and flavouring curries and soups. Seeds are also considered to be carminative diuretic stomatic tonic antibilious and aphrodisiac (Murty and Sridhar, 2001) [7]. It has been reported that the productivity of varieties of coriander has come to stagnate with prevailing management practices. Therefore, it was felt necessary to look for the use of PGRs to break the yield stagnation of these important varieties and its differential effect in term of yield and quality under normal and late sown conditions. Thus, for exploitation of genetic yield potential of the crop to the economic maxima with low cost technology, time of sowing, varieties and application of plant growth regulators are the important deciding factors. However, a measure research work on the agronomical manipulation of the crop involving these factors has been done. The foliar application of stress mitigating chemicals might be act as a powerful tool in enhancing the growth, productivity, quality and also in combating the ill effects generated by various biotic and abiotic stresses in plant in the near future. Their application therefore holds a great promise as a management tool for providing tolerance to food crops against their stresses thereby adding to enhance potential crop yield and alleviating hunger and malnutrition in the ever increase human population of the world.

Materials and methods
A field experiment comprising twenty four treatment combinations replicated three times, was conducted in Randomized Block Design with four coriander varieties [RCr-435, RCr-728, RCr-436, RCr-41] and six treatments of Stress mitigating chemicals (Water spray (Control), Salicylic acid @ 100 ppm spray twice at 40 and 60 DAS, Thiourea @ 500 ppm spray twice at 40 and 60 DAS, Kinetin @ 30 ppm spray twice at 40 and 60 DAS, DMSO @ 78g/ha spray

twice at 40 and 60 DAS and TGA @ 100 ppm spray twice at 40 and 60 DAS) during *rabi*, 2016-17 at S. K. N. College of Agriculture, Jobner (Rajasthan). The soil of experimental field was loamy sand in texture, alkaline in reaction (pH 8.2), low in organic carbon (0.14%), available nitrogen (130 kg/ha), available phosphorus (18.8 kg P_2O_5/ha) and medium in potassium (175.6 kg K_2O/ha) content. The crops were sown on 5th November 2016 in lines 30 cm apart for sole crops with recommended package of practices. A basal dose of 30 kg N/ha and full dose of phosphorus and potassium was drilled about 5-7 cm deep through Urea, DAP and MOP at sowing. Remaining dose of nitrogen through urea was applied in two equal splits with irrigation. The experimental data was analyzed statistically by the method of analysis of variance as out lined by Panse & Sukhatme (1995). The significance of treatment effect was determined using F- test at 5% level of significance. The mean difference between the treatments was compared using the least significant difference (LSD).

Results and Discussion

Performance of varieties

Undoubtedly, the values of growth parameters (plant height, branches per plant, dry matter accumulation), yield attributing parameters (umbels/plant, seeds/umbel), productivity in terms of grain (17.97 q/ha) and stover yield (27.47 q/ha) and quality parameters viz. protein and oil content realized with variety "RCr-728" were significantly higher over rest of the varieties where as umbellets/umbel and test weight were significantly higher in variety RCr-436. The higher biomass accumulation and its efficient reallocation to sink consequently improved in yield attributes, grain and stover yield of "RCr-728". It is an established fact that growth, development and yield potential of crop/variety is an outcome of genomic, environmental and agronomic interactions. Since, these varieties were grown under identical agronomic (management) practices and environmental conditions; the observed variation in overall growth of varieties seems to be due to their genetic milieu. The better growth of RCr-728 as compared to other varieties was also observed by many workers (Balai and Keshwa, 2010) [4] and the marked variation in various yield components and yield between these varieties RCr-728, RCr-435, RCr-436 and RCr-41 was also observed under multilocation trials conducted under AICRP on spices (AICRPS, 2010, 2011 and Balai and Keshwa, 2010) [1-2, 4]. The improvement in protein content of grain "RCr-728" seems to be on account of increased N content of grain and stover.

Stress mitigating chemicals

Foliar application of all stress mitigating chemicals significantly increased the growth parameters viz., plant height, number of branches/plant, dry matter accumulation/metre row length over water sprayed control. The increase in growth parameters due to all stress mitigating chemicals may be attributed to the enhanced physiological activities like cell division, cell elongation, photosynthesis and translocation of nutrients and photosynthates (Meena, 2011) [6] in coriander. Foliar spray of thiourea, remaining at par with salicylic acid, significantly increased these all parameters. The favourable effect of thiourea on plant growth might be due to improved photosynthetic efficiency. The pronounced effect of thiourea on growth characters might be attributed due to its dormancy breaking and germination stimulating effect. In the present study thiourea also maintained large number of green leaves such effects of thiourea might have favoured canopy photosynthesis and hence large accumulation of photosynthate during seed development. Protein and essential oil content in seed was due to higher nitrogen concentration in seed. The similar results were also reported by Bochalia *et al*. (2011) [5] in fenugreek, Balai (2005) [3] and Meena (2011) [6] in coriander.

Table 1: Effect of varieties and stress mitigating chemicals on growth and yield parameters of coriander

Treatment	Plant height (cm)	Number of branches per plant	Dry matter accumulation per metre row length (g)			Umbels/ plant	Umbellets/ umbel	Seeds /umbel	Test weight (g)
			45 DAS	90 DAS	At harvest				
Varieties									
RCr-435	87.83	6.42	3.22	41.00	65.00	19.46	5.88	26.15	10.17
RCr-728	99.50	6.87	3.35	42.16	68.18	22.08	5.44	29.22	8.72
RCr-436	76.33	6.45	3.19	40.67	64.68	19.84	6.13	26.86	10.22
RCr-41	97.11	5.35	2.42	37.33	55.74	18.05	5.32	23.97	8.66
SEm+	1.72	0.13	0.06	0.80	1.24	0.44	0.11	0.50	0.18
CD (P=0.05)	4.97	0.38	0.17	2.31	3.58	1.26	0.31	1.43	0.53
Stress mitigating chemicals									
Control	80.43	5.63	2.74	35.74	56.47	18.02	4.98	21.24	7.59
Salicylic acid (100 ppm)	93.18	6.45	3.16	42.00	64.54	20.76	5.80	28.22	9.50
Thiourea (500 ppm)	99.11	6.88	3.35	44.75	68.89	21.31	6.16	29.96	11.16
Kinetin (30 ppm)	89.18	6.23	3.00	39.49	63.48	19.69	5.74	27.03	9.46
DMSO (78 g/ha)	87.43	6.13	2.99	39.26	63.40	19.64	5.73	25.71	9.45
TGA (100 ppm)	91.83	6.33	3.03	40.51	63.63	19.73	5.75	27.13	9.49
SEm+	2.11	0.16	0.07	0.98	1.52	0.54	0.13	0.61	0.22
CD (P=0.05)	6.09	0.47	0.21	2.83	4.39	1.55	0.37	1.75	0.65
CV (%)	8.10	9.07	8.21	8.43	8.30	9.35	7.89	7.92	8.23

Table 2: Effect of varieties and stress mitigating chemicals on yield and quality parameters of coriander

Treatment	Seed yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index (%)	Protein content (%)	Oil content (%)
Varieties						
RCr-435	13.60	38.85	52.45	25.89	19.68	0.38
RCr-728	14.82	42.03	56.85	26.03	20.87	0.41

RCr-436	13.84	39.00	52.84	26.16	19.99	0.38
RCr-41	12.53	36.61	49.14	25.46	18.62	0.35
SEm+	0.27	0.77	1.04	0.52	0.37	0.01
CD (P=0.05)	0.78	2.22	3.00	NS	1.06	0.02
Stress mitigating chemicals						
Control	11.63	34.90	46.53	24.98	17.94	0.34
Salicylic acid (100 ppm)	14.29	40.48	54.77	26.08	20.56	0.39
Thiourea (500 ppm)	15.19	42.22	57.41	26.45	21.75	0.41
Kinetin (30 ppm)	13.65	38.98	52.63	25.92	19.44	0.38
DMSO (78 g/ha)	13.43	38.69	52.12	25.76	19.38	0.37
TGA (100 ppm)	13.97	39.49	53.46	26.12	19.69	0.38
SEm+	0.33	0.94	1.27	0.64	0.45	0.01
CD (P=0.05)	0.96	2.72	3.68	NS	1.29	0.02
CV (%)	8.39	8.34	8.35	8.50	7.85	7.82

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