

Physiological parameters and their relation to seed yield in coriander (*Coriandrum sativum* L.)

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Abstract

An experiment was conducted to study the morpho-physiological and plant water relation parameters of coriander genotypes and their correlation with seed yield to find out suitable parameters to be used in screening of large number of germplasm for yield and related characters. Genotype ACr 1 showed more root weight than shoot weight throughout the growth period. Rate of photosynthesis was more ($6.63 \mu\text{mol}/\text{m}^2/\text{s}$) in genotype ACr 1 at 30 DAS (Days After Sowing) as compare to Genotype RCr 1 ($4.67 \mu\text{mol}/\text{m}^2/\text{s}$). In genotype RCr41 shoot and root length parameters at early growth stages showed direct effect on seed yield and at 60 DAS major growth parameters showed direct and positive relation with yield. In genotype ACr1 shoot length at 45 DAS and root length at 60 DAS showed significant relation with yield. Hence, these two parameters can be selected for screening of germplasm for higher yield.

Key words : Morpho-physiological parameters, plant water relation parameter, coriander.

Introduction

Coriander (*Coriandrum sativum* L.) is a culinary and medicinal plant from the Apiaceae family and cultivated for both seed as well as tender leaves. This plant has been used as flavouring agent in food products, perfumes and cosmetics. As a medicinal plant, *C. sativum* L. has been credited with a long list of medicinal uses. Powdered seeds or dry extract, tea, tincture, decoction or infusion have been recommended for dyspeptic complaints, loss of appetite, convulsion, insomnia and anxiety (Emamghoreishi *et al.*, 4). Moreover, the essential oil and various extracts from coriander have been shown to possess antibacterial (Burt, 1; Cantore *et al.*, 2; Kubo *et al.*, 7), antioxidant (Wangenstein *et al.*, 8), anti diabetic (Gallagher *et al.*, 5), anti cancerous and anti mutagenic (Chithra and Leelamma, 3) activities. In India, major coriander growing area is lying in semi arid climate where coriander is cultivated on conserved moisture in rabi season. India is the largest producer of coriander (*Coriandrum sativum* L.) in the world and Rajasthan alone occupies an area of 2.4 lakh hectare with the production of 2.8 MT contributing almost 80% of total country's production with a productivity level of 1200 Kg per hectare. However, the realized productivity of the crop is low in Rajasthan as compare to its genetic potential. Several factors including genetic and environmental stresses are responsible for this low productivity. There is enough variability available in existing coriander germplasm and many high yielding genotypes have been identified and released as variety through selection for cultivation in arid and semi arid areas of India. Germplasm evaluation is

being carried out on the basis of morphological parameters by growing the germplasm in the cropping season. Present investigation was conducted to study the morpho-physiological parameters and to find out their correlation with yield. Search of literature reveal that no report is available on physiological parameters in coriander and other seed spice crops. In present investigation morpho-physiological and plant water relation parameters have been recorded at different growth stages to see temporal variation in these parameters. Further, these parameters were correlated with yield to find out suitable parameters for screening of genotypes for higher yield.

Material and methods

An experiment was conducted during 2008 to 2011 at NRCSS, Ajmer to find out morpho-physiological and plant water relation parameters in coriander genotypes and their relation with seed yield. The seeds of two genotypes of coriander (ACr 1 and RCr 41) were collected from seed store of NRCSS, Ajmer and sown in randomized block design with three replications. Morphological parameters viz. fresh weight (gm), dry weight (gm), shoot weight (gm), shoot length (cm), root weight (gm), root length (cm), number of branches, seed yield per plant (gm) were recorded at 45 Days After Sowing (DAS), 60 DAS, 90 DAS and at harvest. From these primary data ratio of fresh weight to dry weight, shoot weight to root weight and shoot length to root length have been worked out. Photosynthetic parameters viz. rate of photosynthesis ($\mu\text{m m}^{-2} \text{s}^{-1}$), rate of transpiration ($\text{m mol m}^{-2} \text{s}^{-1}$), leaf temperature ($^{\circ}\text{C}$), difference between air to leaf temperature ($^{\circ}\text{C}$) and Photosynthetically Active Radiation ($\text{mol m}^{-2} \text{s}^{-1}$)

were recorded with the help of CID Photosynthesis System. Chlorophyll 'a', chlorophyll 'b' and total chlorophyll (mg g⁻¹ fwt) was measured as per Hiscox and Israelstam 6. Plant water relation parameters viz. water potential (Mpa), osmotic potential (Mpa) and turgor potential (Mpa) were also recorded at pre flowering and flowering stages. Twig water potential was measured by soil moisture analysis system (Plant Water Status Console, Soil moisture equipment corporation, USA). Leaves from the same twig were placed in a disposable syringe and put in deep freezer. On next day the syringes were put at room temperature for thawing of frozen leaves. After thawing one drop of leaf sap was extracted by pressing the piston of syringe and directly placed on chamber of vapour pressure osmometer (Licor) to measure osmotic potential. Turgor potential was measured with the following equation:

$$(-\Psi_w) = (-\Psi_s) + (\Psi_p)$$

Where, $(-\Psi_w)$ = Water potential, $(-\Psi_s)$ = Osmotic potential, Ψ_p = Turgour potential

Pearsons Correlation of morpho-Physiological parameters with seed yield was worked out using statistical programme of Microsoft excel.

behaviour. ACr 1 showed more root weight than shoot weight throughout the growth period. There is no significant variation in number of branches til 75 DAS, however, at 90 DAS and harvest genotype ACr 1 showed more branches (10.64 plant⁻¹) than RCr 41 (9.00 plant⁻¹) (Table 1). Root length of both the genotypes was at par while shoot length was at par up to 75 DAS and then genotype ACr 1 showed more shoot length (80.98 cm) than genotype RCr 41 (75.56 cm). Dry weight was more in ACr 1 (6.44 gm plant⁻¹) than RCr 41 (3.80 gm plant⁻¹). Seed yield was, however more in genotype RCr 41 being observed 6.0 gm plant⁻¹ than ACr 1 (3.8 gm plant⁻¹)

Temporal variation in photosynthetic parameters in coriander genotypes at 30, 45 and 60 DAS was presented in table 2. Rate of photosynthesis was more (6.63 $\mu\text{mol}/\text{m}^2/\text{s}$) in genotype ACr 1 at early growth stage (30 DAS) as compare to RCr 1 (4.67 $\mu\text{mol}/\text{m}^2/\text{s}$). At later stages rate of photosynthesis was at par in both the genotypes. Transpiration rate was also at par in both the genotypes up to 45 DAS, however it was more in genotype ACr 1 (0.70 $\mu\text{mol}/\text{m}^2/\text{s}$) as compare to RCr 41 (0.35 $\mu\text{mol}/\text{m}^2/\text{s}$). Difference between air to leaf temperature (TA-TL) was

Table 1: Temporal variation in growth parameters in Coriander

Genotypes	Fresh weight (g)	Shoot weight (g)	Root weight (g)	No. of branches	Root length (cm)	Shoot length	Dry weight (g)	Seed yield (g/plant)
45 DAS								
RCr 41	1.154	0.630	0.578	2.387	5.656	9.577	0.211	
Acr 1	1.206	0.475	0.734	2.443	5.599	9.200	0.204	
75 DAS								
RCr 41	3.372	1.591	1.780	3.399	7.991	15.299	1.252	
Acr 1	3.896	1.506	2.397	3.599	7.931	15.344	1.654	
90 DAS								
RCr 41	9.922	4.489	5.508	7.912	11.178	22.806	1.800	
Acr 1	11.106	3.678	7.453	8.690	12.467	25.422	1.923	
Harvest								
RCr 41	26.511	16.035	9.444	9.001	13.033	75.562	3.805	6.00
Acr 1	25.348	13.488	10.187	10.644	13.442	80.980	6.442	3.80

Results and Discussion

Table 1 revealed temporal variation in growth parameters of coriander genotypes. Genotype ACr 1 showed more fresh weight ranging from 1.206 g at 45DAS to 25.348 g at harvest as compare to genotype RCr 41. At harvest both the genotypes showed at par fresh weight. Genotype ACr 1 belongs to medium maturity group while RCr 41 is a late maturing genotype and has different growth

more (4.01°C) in genotype RCr 41 at early stage (30 DAS) but as the growth stage proceeds this difference was found more in genotype ACr 1 being observed 2.11°C as compare to RCr 41 where the difference was observed 1.00°C. More difference is indicative of more transpiration, hence able to cool the leaves more effectively.

In genotype RCr 41 except root length and ratio of shoot weight to root weight all growth parameters showed

Table 2: Temporal variation in photosynthetic parameters in coriander

Variety	PAR μmol/m ² /s	Leaf Temperature (°C)	TA-TL (°C)	Photo synthesis μmol/m ² /s	Transpiration rate μmol/m ² /s	Stomatal Conductance μmol/m ² /s	Seed yield (g/plant)
30 DAS							
RCr 41	602.21	27.99	4.01	4.67	1.15	432.48	
ACr 1	974.60	29.13	2.87	6.63	1.78	311.24	
45 DAS							
RCr 41	1160.92	29.94	0.72	4.20	0.98	124.50	
ACr 1	732.98	29.50	1.00	3.12	1.24	180.64	
60 DAS							
RCr 41	1293.94	29.00	1.00	1.70	0.35	36.54	6.00
ACr 1	1337.14	27.89	2.11	1.59	0.70	39.47	3.80

positive correlation with seed yield per plant. This correlation was significant for shoot length and ratio of shoot length to root length at 45 DAS. As the growth stage advanced up to 60 DAS all the growth parameters exhibited significant positive correlation with seed yield except ratio of fresh weight to dry weight and shoot length to root length. At 90 DAS no clear correlation was noticed except the ratio of shoot length to root length which was significant and positively correlated with seed yield. At terminal growth stage (120 DAS) fresh weight, root weight, shoot weight, number of branches, dry weight showed significant positive correlation with yield in genotype RCr 41 (Table 3). In Genotype ACr 1 no significant correlation was observed between growth parameters with seed yield except root length at 60 DAS which was positively

correlated. At 90 DAS most of the parameters are negatively correlated with seed yield in genotype ACr 1 except ratio of fresh weight to dry weight and ratio of shoot length to root length. However, at maturity a positive correlation was observed between all the growth parameters and seed yield except root length and ration of fresh weight to dry weight (Table 3).

In genotype RCr41 shoot and root length parameters at early growth stages are important in predicting yield. At 60 DAS major growth parameters showed direct and positive relation with yield. But in ACr1 shoot length at 45 DAS and root length at 60 DAS showed significant relation with yield. Hence, these two parameters can be selected for screening of germplasm for higher yield.

Total chlorophyll content was more (1.809 mg/g FWt) in RCr 41 at 75 DAS and in ACr 1 (1.576 mg/g FWt) at 100

Table 3. Growth parameters and their correlation with seed yield in coriander

	Seed Yield/plant (g)							
	45 DAS		60 DAS		90 DAS		120 DAS	
	RCr 41	Acr 1	RCr 41	Acr 1	RCr 41	Acr 1	RCr 41	Acr 1
FWt	0.272	-0.095	0.569*	-0.036	-0.042	-0.508*	0.871*	0.935*
RWt	0.331	0.108	0.505*	0.004	-0.320	-0.508*	0.890*	0.452
SWt	0.263	-0.193	0.568*	-0.038	-0.027	-0.315	0.780*	0.897*
NuB			0.336	-0.038	-0.221	-0.565*	0.688*	-0.258
Rlen	-0.214	-0.296	0.591*	0.574*	-0.142	-0.589*	-0.133	-0.519
Slen	0.595*	-0.504*	0.668*	0.218	0.322	-0.409	-0.091	0.492
DWt	0.112	-0.117	0.522*	-0.130	0.040	-0.781*	0.811*	0.949*
FWt/DWt	0.250	0.067	-0.112	0.379	-0.280	0.585*	-0.629*	-0.753*
SWt/RWt	-0.318	-0.213	0.202	-0.064	0.169	-0.314	-0.467	0.648*
Slen/Rlen	0.567*	-0.225	-0.126	-0.243	0.651*	0.456*	0.074	0.720*

Table 4. Temporal variation in chlorophyll content and plant water relation parameters in coriander genotypes

Chlorophyll content (mg/g FWt)						
	Chlorophyll 'a'		Chlorophyll 'b'		Total chlorophyll	
	75 DAS	100 DAS	75 DAS	100 DAS	75 DAS	100 DAS
RCr 41	0.027	0.022	0.010	0.007	1.809	1.446
Acr 1	0.026	0.024	0.009	0.007	1.752	1.576

Plant water relation parameters						
	Pre flowering stage			Flowering stage		
	WP (Mpa)	OP (Mpa)	TP (Mpa)	WP (Mpa)	OP (Mpa)	TP (Mpa)
RCr 41	0.89	1.57	0.68	1.18	1.24	0.06
Acr 1	0.77	1.55	0.78	1.14	1.22	0.08

DAS. Genotype ACr 1 showed more turgor pressure at both flowering and post flowering stages. There was no significant variation in water potential, osmotic potential and turgor potential of both the genotypes. Both genotypes RCr 41 and ACr1 maintained slight positive turgor at maturity stage being observed 0.06 and 0.08 MPa respectively.

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