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RESEARCH ARTICLE

Assessment of growth and essential oil profiling in leafy coriander (*Coriandrum sativum* L.) genotypes

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Abstract

Coriander is a versatile plant prized for its dual role as a culinary spice and a medicinal herb. Leafy coriander, an herbaceous plant, is particularly noted for its rich content of bioactive compounds, such as essential oils, flavonoids, and vitamins. The experiment was conducted at the Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. A study was conducted using a Randomized Block Design (RBD) with two replications, focusing on critical growth and yield traits. Among the fifteen genotypes evaluated, the CSL1 genotype illustrates superior performance in various growth and yield parameters. Coriander leaves are extensively studied for their antioxidant, anti-inflammatory, and antimicrobial properties, underscoring their significance in nutritional and medicinal contexts. In this research, coriander leaf oil was extracted and analysed using gas chromatography-mass spectrometry (GC-MS) to determine its chemical composition. The GC-MS analysis identified 60 distinct compounds in the essential oil, with the major constituents being 3-dimethylamino acrylonitrile, trans-2-Dodecen-1-ol, Cyclooctane, Decanal, 13-Octadecenal, 9-Decen-1-yl acetate and 2-Propen-1-amine. These results offer valuable insights into the unique chemical profile of coriander leaf oil, contributing to its distinctive aroma and potential applications in flavouring fragrance and therapeutic formulations.

Keywords

coriander; herbage; essential oil; GC-MS

Introduction

Coriander (*Coriandrum sativum* L.), a member of the Apiaceae family, is a glabrous, aromatic and herbaceous annual plant with a longstanding history as a culinary herb, valued for its aromatic compounds. Though originally from the Mediterranean, coriander has been extensively domesticated across vast areas of Asia, Europe and North America (1). Leafy coriander essential oil is a significant component with many uses in both culinary and therapeutic applications. Coriander is necessary because of its extensive application as a spice and herb. India is the world's top coriander producer, owing to its vast farmlands, ideal weather, and excellent cultivation conditions. The states of Rajasthan, Andhra Pradesh and Gujarat play a significant role in this high production output, contributing the largest shares to the country's overall coriander cultivation.

Additionally, Indian farmers employ traditional cultivation methods

combined with modern farming techniques, ensuring high-quality yields. Fresh coriander leaves are consumed as "asotu" in eastern Anatolia as well as "cilantro" in the United States (2), which is highly valued for both its fragrant leaves and the powerful essential oils it contains. Bioactive substances like (E)-2-decenal, decanal, (E)-2-dodecenal and (E)-2-tetradecenal are abundant in leafy coriander oils (3), which add to their unique aroma as well as an extensive array of medicinal qualities. Due to its antibacterial, antioxidant and anti-inflammatory properties, leafy coriander essential oil has received much attention. It is now a crucial component of both conventional medicine and contemporary natural therapies (4).

Additionally, coriander is utilized as a natural remedy for various illnesses, including diarrhoea, vomiting, jaundice, stomach issues and diarrhoea (1,5). As a flavouring and adjuvant, *Coriandrum sativum* helps in food preparation, preservation, and avoiding foodborne illnesses and spoilage (5). Furthermore, coriander essential oil is utilized in the flavouring and fragrance industries, improving the sensory aspects of food products and perfumes. The growing demand for natural and plant-based products has further amplified the importance of coriander essential oil, positioning it as a valuable asset in the health and wellness sectors. This introduction aims to provide an overview of the significance of critical oil in leafy coriander, highlighting its nutritional and medicinal benefits and broader applications.

Materials and Methods

The current research was conducted at the Department of Spices and Plantation Crops, Horticultural College and Research Institute, Coimbatore, from 2023 to 24. This study aims to evaluate the leafy coriander (*Coriandrum sativum* L.) genotypes for growth and yield. The coriander genotypes were raised in open-field conditions in a randomized block design with two replications. Fifteen different genotypes *viz.*, CSL1,CSL2,CSL3,CSL4,CSL5,CSL6,CSL7,CSL8,CSL9,CSL10,CSL11,CSL12,CSL13,CSL14,CSL15 were used for the study. Line sowing of coriander was done. The seeds were split into halves by rubbing on a hard surface before sowing. Bed sizes of 3×1.5 m^2 were prepared, and sowing was taken up at a spacing of 30 cm between lines. The Plant growth parameters were recorded, *viz.*, Number of days taken for germination, plant height (cm), fresh plant weight, Number of branches per plant and number of leaves per plant. The yield parameters recorded included measurements such as fresh shoot weight, root weight, herbage yield per plot and essential oil content.

The experiment used a randomized block design (RBD), 15 treatments, and 2 replications. Statistical analysis was carried out by adopting the procedure described by Panse and Sukhatme (6).

Plant materials

The Fifteen leafy coriander genotypes *Viz.*, CSL1, CSL2, CSL3, CSL4, CSL5, CSL6, CSL7, CSL8, CSL9, CSL10, CSL11, CSL12, CSL13, CSL14, CSL15 exhibiting distinct morphological traits were cultivated and assessed in the experimental plot of the Department of Spices and Plantation Crops, Horticultural College and Research Institute, Coimbatore. The genotypes were collected from different regions, as mentioned in Table 1.

Isolation of essential oil

A Clevenger apparatus and a hydro-distillation procedure were used to extract the essential oil from 200 g of fresh *Coriandrum sativum* leaves. The leaves were chopped into small pieces before being hydro-distilled in 500 ml of water. After operating nonstop for three hours, a layer of essential oil was carefully extracted with a micropipette, and no increase in crucial oil quantity was noticeable for longer than an hour. The water from the oil was removed using anhydrous sodium sulphate. Once the proper amount of light yellowish oil was gathered, the proportion (W/W) was determined (7,8).

Estimation of composition of essential oil through GC-MS

The system consists of a gas chromatograph linked to a mass spectrometer (GC-MS) outfitted with an Elite-I fused RMS 5 silica capillary column made entirely of dimethylpolysiloxane. An electron ionisation device with an ionising energy of 70 eV was used to detect. An electron ionisation device with an ionising energy of 70 eV was used to detect. The sample injection volume was 1ml with a sample split ratio of 10:1 and the carrier gas was helium (99.9%) at a constant flow rate of 1 ml/min. The ion source and injector temperatures were adjusted to 250°C and 260° C, respectively. The oven was set to begin at 110°C and rise by 5°C every minute until it reached 260°C, where it was isothermal for three minutes. Mass spectra covering fragments ranging from 50 to 650 Da were acquired using a 0.5-second scan interval. Turbo mass software was used to manage mass spectra and chromatograms and the average peak area of each component was compared to the overall area to calculate its percentage composition.

Table 1. Detail of Genotypes Under Studies

CSL-1	ISP-171	Regional research station, Vridhachalam
CSL-2	RMT-5	Regional research station, Vridhachalam
CSL-3	COR-203	HC&RI, TNAU, Coimbatore
CSL-4	COR-196	HC&RI, TNAU, Coimbatore
CSL-5	A1	Anantharajupeta, Andra Pradesh Dr. Y. S. R, Horticultural university
CSL-6	Parimala	Chikkamagaluru dist. Karnataka
CSL-7	COR-206	HC&RI, TNAU, Coimbatore
CSL-8	A2	Anantharajupeta, Andra Pradesh Dr. Y. S. R, Horticultural university
CSL-9	COR-202	HC&RI, TNAU, Coimbatore
CSL-10	Vilathikulam	Vilathikulam
CSL-11	Chikkamagaluru	Chikkamagaluru dist. Karnataka
CSL-12	COR-193	HC&RI, TNAU, Coimbatore
CSL-13	CO-4	HC&RI, TNAU, Coimbatore
CSL-14	AGCR-1	NRCSS, Ajmer, Rajasthan
CSL-15	Virudhanagar	Virudhanagar

Results

Growth parameters

The information regarding growth characters, such as the number of days required for germination, number of branches per plant, plant height, plant weight and shoot weight for various genotypes, are reported in Tables 2 and 3.

Days taken for germination range from 10.5 to 15.25 days (Table 2). CSL6, CSL10 and CSL13 took minimum days for germination, followed by CSL1, recording 10.75 days and CSL7 taking maximum days for germination (15.25 days). The genetic properties of the genotypes and environmental influence might cause variance in the number of days taken for germination.

Plant height at 20 DAS (Days after sowing) ranges from 5.90 cm to 7.74 cm (Table 2). CSL1 showed maximum plant height (7.74 cm) followed by CSL2 (6.98 cm) and minimum plant height in CSL15 (5.90 cm). In 30 DAS, plant height ranges from 10.56 cm to 13.26 cm (Table). CSL1 showed maximum plant height (13.26 cm) followed by CSL2 (13.00 cm) and minimum plant height in CSL15 (10.56 cm). In the harvesting stage, plant height ranges from 21.84 cm to 28.80 cm (Table 2). CSL1 showed the maximum plant height (28.80 cm), followed by CSL2 (28.44 cm) and the minimum plant height shown in CSL11 (21.84).

Significant variation in plant weight was observed among the fifteen genotypes. Genotype CSL1 and CSL15 showed the maximum and minimum plant weight at 20 DAS (1.12 g and 0.42 g), 30 DAS (1.99 g and 1.00 g) and at harvest (11.09 g and 4.09 g), respectively (Table 1). The genetic variation and its expression in the growing condition and soil may cause these variations.

Fresh root lengths were recorded in 20 DAS and 30 DAS and at harvest ranges from 2.75 to 5.85 cm, 4.25 to 9.35 cm and 6.55 cm to 11.30 cm, respectively, of fifteen different genotypes (Table 4). In all these conditions, *i.e*., 20 DAS, 30 DAS and at harvest, CSL1 recorded maximum root length (5.85 cm, 9.35 cm and 11.3 cm), followed by CSL2 (5.80 cm, 8.95 cm and 10.95 cm) and minimum root length has been recorded in CSL15 (2.75 cm, 4.25 cm and 6.55 cm) respectively. The root length of genotypes varies due to genotypic traits and environmental influence.

The number of branches ranges from 6.50 to 9.95 (Table 3). The maximum number of branches was recorded in CSL1 (9.95), followed by CSL13 (9.50) and CSL6 (6.50), having a minimum number of branches. The genetic makeup and how it expresses itself in the growing soil and season may cause these variation in the number of branches per plant (10).

Table 2 Mean value of Coriander genotypes for growth characters.

Genotypes	Days taken for germination	Plant height (cm)			Plant weight (g)			Fresh root length (cm)		
		20 DAS	30 DAS	At Harvest	20 DAS	30 DAS	At Harvest	20 DAS	30 DAS	At Harvest
CSL1	10.75	7.74	13.26	28.80	1.12	1.82	11.09	5.85	9.35	11.30
CSL2	11.00	6.98	13.00	28.44	1.01	1.76	10.64	5.80	8.95	10.95
CSL3	12.75	6.53	11.31	27.08	0.66	1.35	7.41	5.10	6.70	8.95
CSL4	14.00	6.36	12.03	27.43	0.67	1.42	7.44	4.95	7.95	9.00
CSL5	12.00	6.56	11.38	26.41	1.01	1.99	7.02	4.75	6.25	8.55
CSL6	10.50	6.41	11.84	27.24	0.68	1.23	7.42	4.35	6.75	9.40
CSL7	15.25	6.48	12.03	27.59	0.71	1.45	7.75	5.05	8.15	9.40
CSL8	13.25	6.58	11.29	25.98	0.69	1.23	6.31	5.50	6.70	8.35
CSL9	13.00	6.03	11.00	26.21	0.78	1.21	6.66	5.10	6.90	9.00
CSL10	10.50	6.28	11.29	26.29	0.54	1.47	6.72	4.60	6.15	8.45
CSL11	12.75	6.19	11.05	21.84	0.64	1.26	6.05	5.05	5.75	8.30
CSL12	11.75	6.31	12.73	28.11	0.92	1.61	8.55	5.10	8.40	9.50
CSL13	10.50	6.30	12.83	27.86	0.97	1.78	8.34	6.60	8.25	9.05
CSL14	13.75	6.49	11.44	26.78	0.97	1.40	7.27	4.40	6.55	8.95
CSL15	13.00	5.90	10.56	22.21	0.42	0.77	4.09	2.75	4.25	6.55
Mean	12.31	6.47	11.80	26.55	0.79	1.45	7.52	4.99	7.13	9.04
Sed	0.41	0.22	0.26	1.26	0.12	0.12	0.56	0.27	0.39	0.24
CD (0.05)	0.88	0.47	0.56	2.72	0.26	0.26	1.20	0.59	0.85	0.53
CV (%)	3.33	3.44	2.21	4.77	15.53	8.47	7.47	5.57	5.56	2.73

Among the genotypes under study, there were notable variations in the number of leaves per plant at various intervals. During the entire three stages, *viz*., 20 DAS, 30 DAS and at harvest shows the maximum number of leaves and minimum Number of leaves, *viz*., 6.95 and 4.30, 11.15 and 8.8, 26.95 and 17.80, respectively (Table 3). At 20 DAS, CSL1 shows the maximum number of leaves (6.95) and the minimum number of leaves was observed in CSL11 (4.30). At 30 DAS CSL1, the maximum number of leaves per plant (11.15) was registered and a minimum number of leaves was recorded in CSL15 (8.80). At harvest, the number of leaves per plant was maximum in CSL1 (26.95) and minimum in CSL15 (17.80). The number of leaves per plant varies within different genotypes due to their genetic characteristics.

The genotype CSL1 recorded maximum fresh leaf weight per plant and CSL15 showed minimum leaf weight per plant in all stages of plant development, *i.e*., 20 DAS, 30 DAS and at harvest (Table 3). At 20 DAS, CSL1 recorded a weight of 0.49 g and a minimum weight in the case of CSL15 (0.14 g). In 30 DAS, CSL1 recorded 0.82 g, and the minimum weight in CSL15 was 0.49 g. CSL1 recorded a maximum weight of 3.76 g at harvest and CSL15 recorded a minimum weight of 1.81 g. Genotype-related variability in leaf weight could be the build-up of biomolecules and other biochemical traits impacted by the shadowed situation.

Yield Parameters

The data on yield characteristics, including the fresh shoot weight, fresh root weight, herbage yield per plot and essential oil content, are presented in Table 4.

Significant differences in shoot weight among the fifteen genotypes were observed in 3 stages, *i.e*., 20 DAS, 30 DAS and at harvest (Table 2). At 20 DAS, CSL1, followed by CSL2, showed maximum shoot weight and CSL15 showed minimum shoot weight ((0.83 g, 0.82 g and 0.23 g, respectively) and at 30 DAS, CSL1, followed by CSL2, showed maximum shoot weight and CSL15 showed minimum shoot weight (1.67 g, 1.64 g and 0.81 g respectively). At the harvesting stage, CSL1, followed by CSL2, showed maximum shoot weight and CSL15 showed minimum shoot weight (10.04 g, 8.58 g and 4.61 g, respectively). Variance in leaf area and Vigor of genotype expressed at various growth stages could cause the variation in shoot weight.

There has been a significant variation in fresh root weight (g) of fifteen genotypes (Table 4). CSL1 recorded the highest fresh root weight in all 20 DAS, 30 DAS and at harvest stages (0.21 g, 0.45 g and 0.74 g, respectively), followed by CSL2 in all 3 stages (0.14 g, 0.33 g and 0.67 g respectively) and CSL15 showed lowest fresh root weight in all three conditions (0.02 g, 0.05 g and 0.18 g respectively).

The Herbage yield ranges from 2.94 to 7.48 kg (Table 4). The maximum herbage yield was shown in CSL1 (7.48 kg), followed by CSL2 (7.04 kg) and CSL15 (2.94 kg), which had minimum herbage yield. The inference aligns with the outcomes of (9,12), as shown in Figure 2.

Significant variation in the Total essential oil content of the plant has been observed among the fifteen genotypes. Genotypes CSL1, CSL6 and CSL2 showed the maximum total essential oil content (0.28 %, 0.27% and 0.25 %, respectively). The minimum essential oil content in the genotype CSL9 (0.10 %) respectively (Table 4). The inference lines up with outcomes of (2,13).

Table 3 Mean value of Coriander genotypes for growth characters

Genotype	No. of branches	No. of leaves per plant			Fresh leaf weight (g)		
		20 DAS	30 DAS	At Harvest	20 DAS	30 DAS	At Harvest
CSL1	9.95	6.95	11.15	26.95	0.49	0.82	3.76
CSL2	9.45	6.30	11.10	26.30	0.45	0.80	3.67
CSL3	7.65	5.10	9.80	22.95	0.26	0.75	3.37
CSL4	8.45	4.95	10.95	23.65	0.27	0.78	3.37
CSL5	8.30	5.30	9.95	21.80	0.37	0.72	2.70
CSL6	6.50	5.45	10.80	23.10	0.34	0.75	3.36
CSL7	7.00	5.10	9.95	23.80	0.36	0.78	3.25
CSL8	8.00	5.30	9.65	19.80	0.39	0.69	2.25
CSL9	7.50	5.15	9.95	20.15	0.33	0.68	2.28
CSL10	8.00	4.65	10.45	20.80	0.21	0.68	2.12
CSL11	8.50	4.30	10.95	18.95	0.37	0.67	2.35
CSL12	7.50	6.10	10.45	25.45	0.38	0.77	3.52
CSL13	9.50	6.15	10.95	24.45	0.36	0.77	3.49
CSL14	9.00	5.50	10.15	20.95	0.38	0.67	2.90
CSL15	8.50	5.30	8.80	17.80	0.14	0.49	1.81
Mean	8.25	5.44	10.33	22.46	0.34	0.72	2.95
SEd	0.57	0.43	0.48	0.62	0.05	0.05	0.26
CD (0.05)	1.23	0.94	1.03	1.34	0.12	0.11	0.57
CV (%)	6.96	8.06	4.66	2.78	16.88	7.29	9.04

Table 4 Mean value of coriander genotypes for yield characters

Genotypes	Shoot weight (g)			Fresh root weight (g)			Herbage Yield (kg)	Total Essential oil content (ml/200 g)
	20 DAS	30 DAS	At Harvest	20 DAS	30 DAS	At Harvest		
CSL1	0.83	1.67	10.04	0.215	0.458	0.743	7.48	0.28
CSL2	0.82	1.64	8.58	0.1445	0.331	0.676	7.04	0.25
CSL3	0.51	1.41	6.00	0.112	0.231	0.3955	3.89	0.12
CSL4	0.53	1.47	6.47	0.1095	0.2395	0.4475	4.01	0.11
CSL5	0.77	1.35	5.61	0.133	0.216	0.3905	3.66	0.14
CSL6	0.55	1.45	6.18	0.1105	0.2235	0.4285	4.44	0.27
CSL7	0.53	1.48	6.56	0.1155	0.254	0.445	4.03	0.12
CSL8	0.52	1.02	5.37	0.102	0.169	0.2625	3.13	0.13
CSL9	0.64	1.01	5.40	0.115	0.173	0.3025	3.43	0.10
CSL10	0.37	1.20	5.58	0.0915	0.191	0.361	3.16	0.16
CSL11	0.30	0.95	5.22	0.089	0.167	0.231	3.02	0.17
CSL12	0.71	1.57	6.66	0.129	0.299	0.504	4.70	0.23
CSL13	0.82	1.51	6.58	0.1235	0.265	0.4975	4.34	0.24
CSL14	0.72	1.44	5.72	0.0945	0.2215	0.394	3.75	0.15
CSL15	0.23	0.81	4.61	0.029	0.1165	0.2275	2.94	0.16
Mean	0.59	1.33	6.30	0.11	0.23	0.42	4.20	0.17
SEd	0.12	0.09	0.37	0.02	0.04	0.07	0.78	0.02
CD (0.05)	0.26	0.20	0.79	0.04	0.09	0.15	1.69	0.04
CV (%)	20.74	7.02	5.90	18.94	18.81	17.24	18.78	12.63

Fig.1. Field view of the experimental plot at the time of the harvesting stage

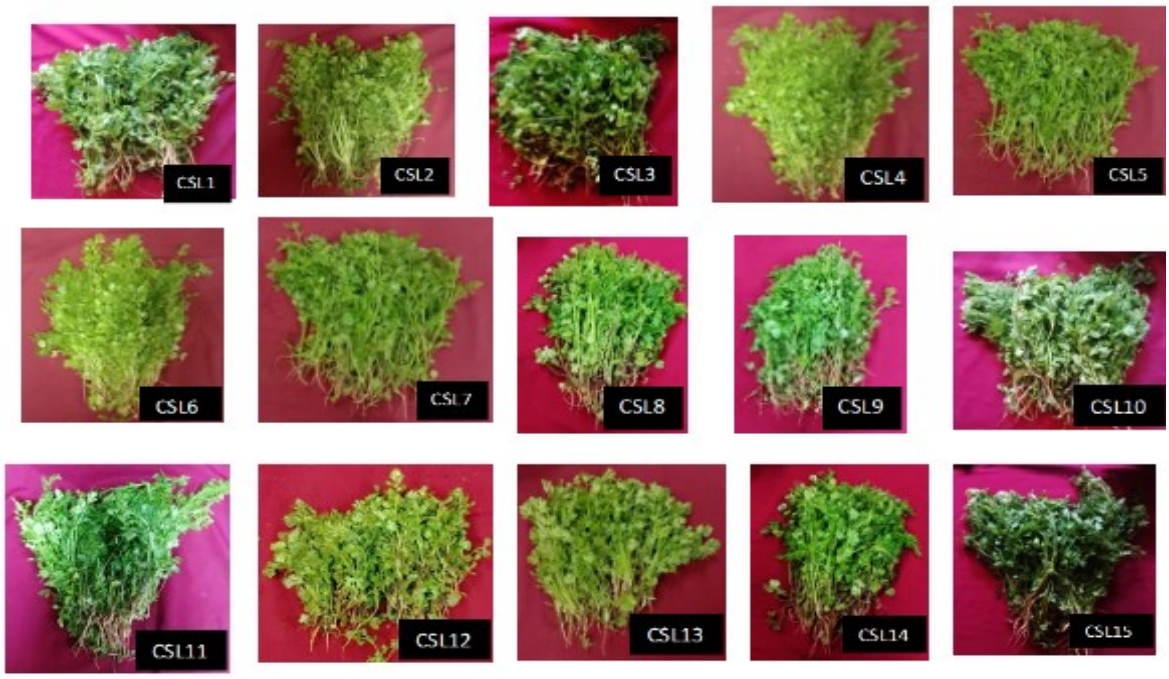


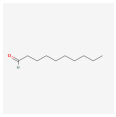
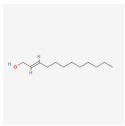
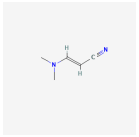
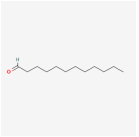
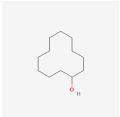
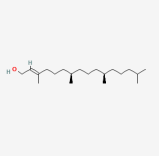
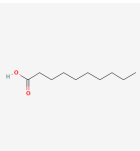
Fig.2. Herbage yield of different coriander genotypes

Metabolomics profiling using gc-ms analysis

The present work hydrodistilled essential oil isolated from coriander (*Coriandrum sativum* L.) leaves, HC&RI and Coimbatore for physicochemical properties and chemical composition. In this investigation, coriander leaf oil was extracted and subjected to gas chromatography and mass spectrometry analysis to determine its chemical composition (GC-MS).

Through GC-MS analysis, 60 chemical components were found and identified in coriander leaf oil. The data in Table 5 showed the Different metabolites present in the oil of leafy coriander genotype CSL1 with their retention time (RT), peak area (%), molecular structure, biological activity and molecular formula. Various metabolites found in the oil profile of CSL1 were depicted in the GC-MS chromatogram and represented in Figure 3. The hydrodistilled essential oil yield from leafy coriander genotype CSL1 was 0.28 % /200 g. Similar results were reported by (2) and (5). Major components noticed in the leafy coriander genotype CSL1 were 3-Dimethylaminoacrylonitrile, trans-2-Dodecen-1-ol, Cyclooctane, Decanal, Dodecanal, 2-Cyclohexen-1-ol,

Table 5 Different metabolites present in the oil of leafy coriander genotype CSL1 with their retention time (RT), peak area (%), molecular structure, biological activity and molecular formula.

Compound	RT	Area %	Molecular structure	Biological activity	Molecular formula
Decanal	6.953	7.48		Antifungal agent, a fragrance and a plant metabolite	C10H20O
Cyclooctane	7.631	20.22		antimicrobial activity, antibacterial and antifungal effects	C8H16
trans-2-Dodecen-1-ol	9.375	27.33		antimicrobial, antioxidant, and anti-inflammatory	C12H24O
3-Dimethylaminoacrylonitrile	11.042	28.76		-	C5H8N2
2-Cyclohexen-1-ol	7.498	3.16		antibacterial activity	C6H10O
Dodecanal	8.831	3.48		antioxidant, anticholinesterase and antibacterial activity	C12H24O
Tetradecanal	10.497	1.24		antibacterial	C14H28O
Cyclododecanol	11.730	1.03		antimicrobial	C12H24O
Phytol	13.919	1.43		Anxiolytic, metabolism-modulating, cytotoxic, antioxidant, autophagy- and apoptosis-inducing, antinociceptive, anti-inflammatory, immune-modulating, and antimicrobial effects	C20H40O
Decanoic acid	14.286	0.80		Antibacterial agent, an anti-inflammatory agent, a human metabolite, a volatile oil component, a plant metabolite and an algal metabolite	C10H20O2

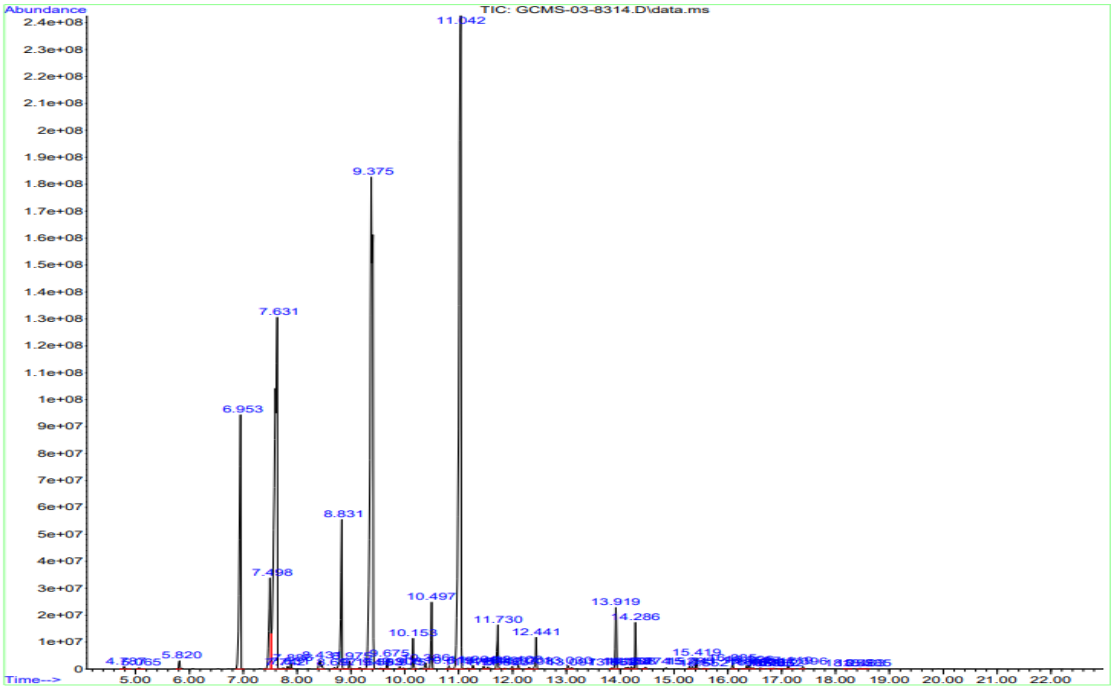


Fig.3. GC-MS chromatogram of the bioactive compound of the oil of leafy coriander genotype CSL1

Phytol, Tetradecanal, Cyclododecanol, Decanoic acid. The maximum peak area was obtained by 3-Dimethylaminoacrylonitrile (28.76%), followed by trans-2-Dodecen-1-ol (27.33%) and Cyclooctane (20.22 %). Cyclohexene obtained the minimum peak area (0.03%).

The metabolites identified in the CSL2 oil profile are shown in Figure 4 with the GCMS chromatogram. In Table 6, the various bioactive chemicals found in the essential oil of the CSL2 genotypes of leafy coriander were enumerated along with their pharmacological activity, molecular formula, peak area (%), retention time (RT) and molecular structure. The hydrodistilled essential oil yield from leafy coriander genotype CSL2 was 0.25 % /200 g. The leafy coriander genotype CSL2 was found to contain the following major components: 13-Octadecenal, 3-Dimethylaminoacrylonitrile, Decanal, 2-Propen-1-amine, Carbonic acid, Phytol, Tetradecanal, 13-Tetradecenal, cis-9-Hexadecenal, Ethanol. The compound 13-Octadecenal (24.36 %) produced the most significant peak area, followed by 3-Dimethylaminoacrylonitrile (20.84 %) and Decanal (19.79 %). Cyclohexene showed the lowest peak area (0.04%).

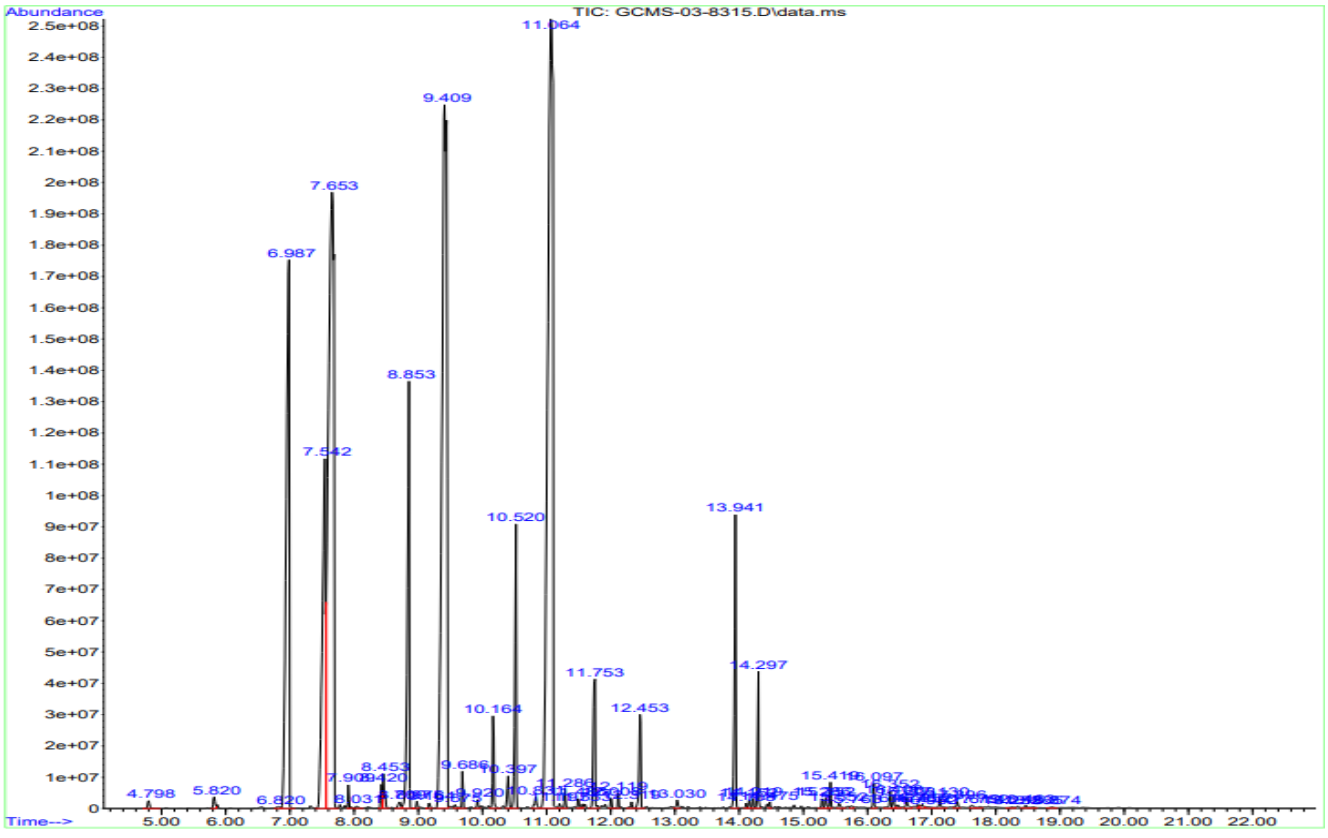
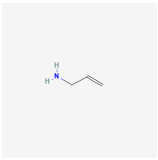
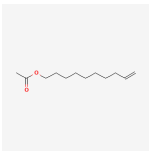
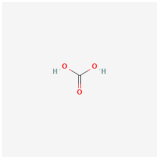
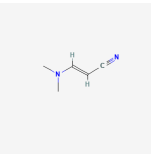
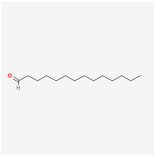
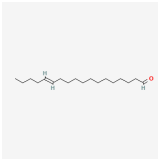
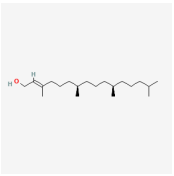
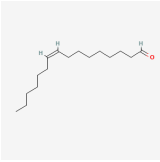


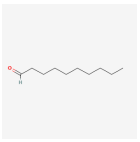
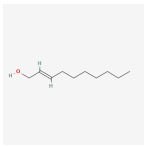
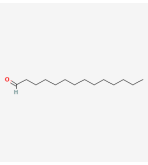
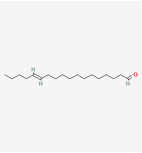
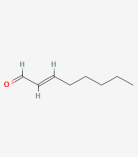
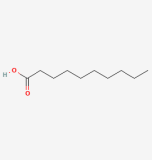
Fig.4. GC-MS chromatogram of the bioactive compound of the oil of leafy coriander genotype CSL2

Table 6 Different metabolites present in the leafy coriander genotype CSL2 oil with their retention time (RT), peak area (%), molecular structure, biological activity and molecular formula.

Compound	RT	Area %	Molecular structure	Biological activity	Molecular formula
2-Propen-1-amine	7.542	7.01		Inhibition of squalene epoxidase blocks the conversion of squalene to lanosterol, leading to squalene accumulation and ergosterol depletion in the cell membrane.	$CH_2CHCH_2NH_2$
Decanal	7.653	19.79		Antifungal agent, a fragrance and a plant metabolite	C12H22O2
Carbonic acid	8.853	4.56		The carbonic anhydrase enzymes work to catalyze the conversion of carbon dioxide and water to the dissociated ions of carbonic acid.	CH2O3
3-Dimethylaminoacrylonitrile	9.409	20.84		-	C5H8N2
Tetradecanal	10.520	2.15		Anthelminthic drug, a plant metabolite and an antibacterial agent	C14H28O
13-Octadecenal	11.064	24.36		Antimicrobial activity	C18H34O
Phytol	13.941	2.26		Anxiolytic, metabolism-modulating, cytotoxic, antioxidant, autophagy- and apoptosis-inducing, antinociceptive, anti-inflammatory, immune-modulating, and antimicrobial effects	C20H40O
cis-9-Hexadecenal	12.453	0.97		Fumigatus melanin biosynthesis	C16H30O
Ethanol	14.297	0.83		Pharmaceutical products, perfume, cosmetics	C2H6O

Various metabolites found in the oil profile of CSL6 were depicted in the GC-MS chromatogram and represented in Figure 5. The different bioactive compounds in the essential oil of leafy coriander genotypes of CSL6 with their retention time (RT), peak area (%), molecular formula, molecular structure and pharmacological activity are listed in Table 7. The hydrodistilled essential oil yield from leafy coriander genotype CSL2 was 0.27 % /200 g. Major components observed in the leafy coriander genotype CSL6 were 2-Decen-1-ol, 13-Octadecenal, 3-Dimethylaminoacrylonitrile, Decanal, 1-Hexadecanol, Carbonic acid, cis-11-Tetradecen-1-ol, Ethanone, 2-Octenal, Decanoic acid. Trans-2-Dodecen-1-ol (22.41%) was utilized to achieve the highest peak area, followed by 13-Octadecenal (21.53 %) and 3-Dimethylaminoacrylonitrile (14.99 %). Fumaric acid produced the lowest peak area (0.04 %).

Table 7 Different metabolites present in the oil of leafy coriander genotype CSL6 with their retention time (RT), peak area (%), molecular structure, biological activity and molecular formula.

Compound	RT	Area %	Molecular structure	Biological activity	Molecular formula
Decanal	6.975	9.15		Antifungal agent, a fragrance and a plant metabolite	C10H20O
1-Hexadecanol	7.531	5.97		antioxidant activity	C16H34O
trans-2-Dodecen-1-ol	7.675	22.41		antimicrobial, antioxidant and anti-inflammatory	C10H20O
Carbonic acid	8.853	4.42		The carbonic anhydrase enzymes work to catalyze the conversion of carbon dioxide and water to the dissociated ions of carbonic acid.	CH2O3
3-Dimethylaminoacrylonitrile	9.408	14.99		-	C5H8N2
Tetradecanal	10.519	2.13		anthelminthic drug, a plant metabolite and an antibacterial agent	C14H28O
13-Octadecenal	11.075	21.53		antimicrobial activity	C18H34O
2-Octenal	11.753	1.65		antifungal activity	C8H14O
Ethanone	13.941	1.99		React with many molecules naturally found in the body, including neurotransmitters and proteins (e.g., enzymes)	CH_3CHO
Decanoic acid	14.297	1.38		antibacterial agent, an anti-inflammatory agent, a human metabolite, a volatile oil component, a plant metabolite and an algal metabolite	C10H20O2

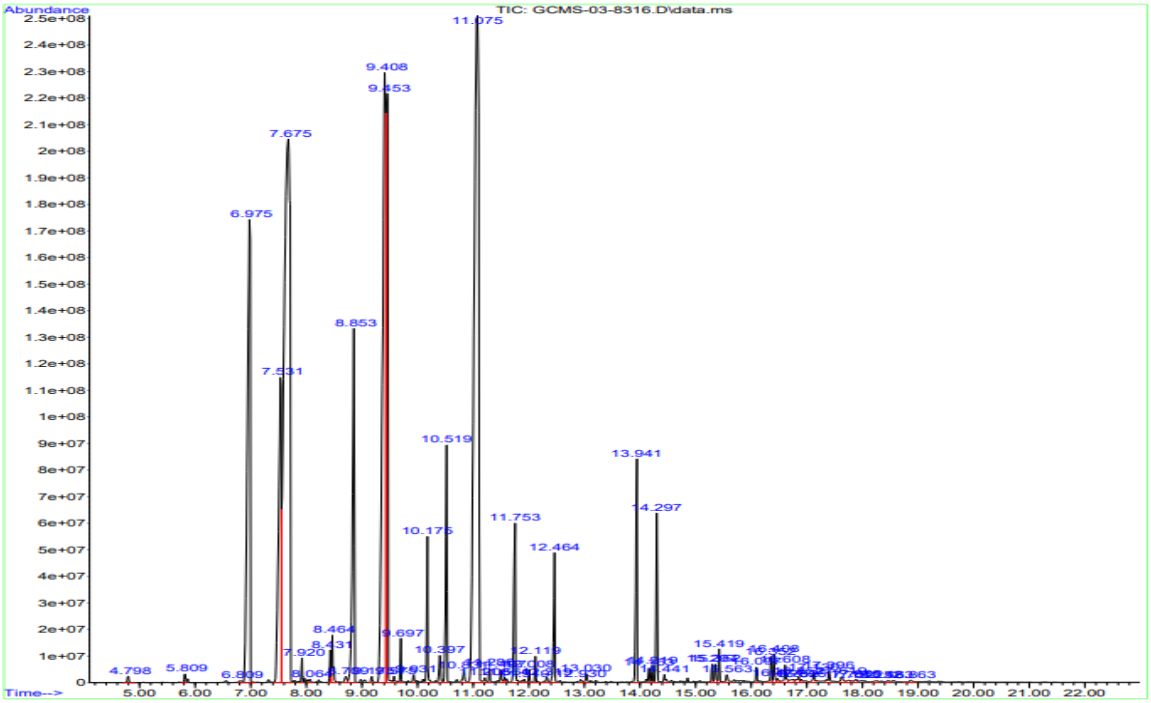


Fig.5. GC-MS chromatogram of the bioactive compound of the oil of leafy coriander genotype CSL6

The GC-MS was used to identify the bioactive compounds in leafy coriander essential oil. Major components present in leafy coriander essential oil of CSL1, CSL2 and CSL6 have significant oil compounds identified in the oil profile, including 3-Dimethylaminoacrylonitrile, trans-2 -Dodecen-1-ol, Cyclooctane, Decanal, Dodecanal, Tetradecanal, 13-Octadecenal, 2-Propen-1-amine, Carbonic acid, trans-2-Dodecen-1-ol, 1-Hexadecanol. These significant components have many pharmacological properties, such as antioxidant, anti-inflammatory, antimicrobial and diuretic properties.

Discussion

Coriander demonstrated significant variability among genotypes, highlighting its potential for genetic improvement. The superior performance of specific genotypes in growth and yield traits underscores the importance of targeted therapeutic uses. Identifying superior genotypes offers promising avenues for enhancing leafy coriander's productivity and commercial value.

The CSL1 genotype demonstrated superior performance in critical growth and yield traits, including days to germination, plant height, branch number per plant, leaf number per plant, leaf weight, fresh plant weight, shoot weight, root length, root weight, dry plant weight and herbage yield per plot. Similar results were reported in (10) and (14).

The success or failure of the crop establishment can be determined by temperature. Temperature is the primary factor for germination. The reduction or inhibition of germination at undesirable temperatures may be due to the reduction or inhibition of enzymatic action at undesirable temperatures (9)

Apical dominance and endogenous hormonal leaves have been shown to be primary factors contributing to the number of leaves per plant (11).

The essential oil profile of leafy coriander genotypes CSL1, CSL2 and CSL6 reveals the presence of significant compounds in essential oil. Among them, 3-Dimethylaminoacrylonitrile is the principal constituent, followed by trans-2-Dodecen-1-ol, Cyclooctane, Decanal, Dodecanal, Tetradecanal, 13-Octadecenal, 2-Propen-1-amine, Carbonic acid, trans-2-Dodecen-1-ol and 1-Hexadecanol. These significant constituents are noted for their diverse pharmacological properties, encompassing antioxidant, anti-inflammatory, antimicrobial and diuretic effects. Such a profile underscores the therapeutic potential of these genotypes, particularly in applications related to health and medicine.

The coriander cultivar "Jantar" is notable for its high content of aliphatic aldehydes, with E-2-dodecanol (17.8%), decanal (15.3%) and E-2-decanol (11.9%) being the predominant components identified in its essential oil (15). The major volatile compounds identified in coriander leaves essential oil in (3) research study were (E)-2-decenal (32.23%), linalool (13.97%), (E)-2-dodecenal (7.51%), (E)-2-tetradecenal (6.56%), 2-decen-1-ol (5.45%), (E)-2-undecenal (4.31%), dodecanal (4.07%), (E)-2-tridecenal (3.00%), (E)-2-hexadecenal (2.94%), pentadecenal (2.47%) and α-pinene (1.9%). (5) reported that (Z)-3-Hexenyl acetate was the primary compound found in all four coriander cultivars, i.e., desi, hybrid, Irani and Peshawari, followed by (Z)-3-Hexenol.

Although the primary components in all investigations were the same, their relative amounts varied. Genetic variables, abiotic pressures, the procedure of extracting oil, variations in climate, altitude, soil composition and the maturation stage at harvest time are some of the possible causes of the variations in the chemical compositions of coriander across different places (16,17).

Conclusion

The CSL1 genotype of leafy coriander exhibited outstanding performance across critical growth and yield parameters, including early germination, increased plant height and enhanced biomass production, making it a promising candidate for high-yield cultivation. The essential oil analysis of the CSL1, CSL2 and CSL6 genotypes revealed a rich profile of bioactive compounds, with 3-Dimethylaminoacrylonitrile being the predominant constituent. The presence of additional compounds such as trans-2-Dodecen-1-ol, Cyclooctane and Decanal, known for their antioxidant, anti-inflammatory, antimicrobial and diuretic properties, highlights the substantial therapeutic potential of these genotypes. These findings suggest that CSL1, in particular, holds significant promise for both agricultural productivity and medicinal applications, offering a dual benefit of high yield and valuable pharmacological properties. This study underscores the importance of integrating genotype selection with essential oil profiling to maximize agronomic and therapeutic outcomes in leafy coriander cultivation.

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Authors' contributions

T M conceived the idea and prepared the first draft of the manuscript. M M edited and finalised the manuscript. R V, R R and M P reviewed the manuscript with valuable inputs, and all authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

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