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Registration of variety: CIM-Surabhi: A linalool rich, high essential oil yielding variety of sweet basil *(Ocimum basilicum)*

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Abstract

The essential oil of sweet basil (family: Lamiaceae) is used in flavour, fragrance, food, oral health preparations and traditional house hold medicines. 189 genetic stocks of Genus Ocimum are available at CSIR-CIMAP for research and exploitation. The essential oil of sweet basil with linalool, linalool acetate in desired combinations are in high demand for making various innovative cosmetic and perfumery products. Applying half sib selection technique on an Ocimum basilicum *population, a new improved cultivar (namely OBC-1) has been developed. This cultivar has been released for its commercial cultivation in the name of variety CIM-Surabhi. Besides being a high linalool containing genotype, this variety will also provide additional income to farmers as it yield higher herb (221.30ql/ha) and essential oil (166 kg/ha) recovery. The oil of this variety is rich in 70-75 % (-) linalool. The (-) linalool in this variety is of 99.14 % purity and is superior to that obtained from lavender. The new cultivar also fits in crop rotation/intercropping between wheat and paddy and with other vegetables crops.*

Introduction

Ocimum (Family: Lamiaceae) is a genus of about 35 species of annual and perennial aromatic herbs and shrubs. Most species are native to the tropical and warm regions of the old world, including India. The essential oil of Indian basil obtained via hydro- or steam distillation of leaves or whole aerial biomass is used to flavour foods, dental care formulations, fragrances, social/religious rituals and traditional house hold medicines. The basil essential oils have also been shown to contain biologically active constituents that have insecticidal, nematicidal, fungistatic or antimicrobial properties.

CSIR-CIMAP, Lucknow has an impressive collection of 189 genetic stocks of nine *Ocimum* species namely, *Ocimum sanctum* (Krishna and Shyam tulsi), *O. kilimandscharicum*, *O. canum, O. gratissimum, O. Africanum, O. viridis, O. tenuiflorum* and *O. Basilicum* (Sweet and French basil) that has opened many possibilities to develop high yielding cultivars/varieties for improved herb and oil yields Chemotype with high value chemical constituents in their oil like linalool. acetate, cinnamate, eugenol etc are in high demand for various innovative cosmetic/ perfumery

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products. Linalool rich chemotypes in particular are required for providing additional income to farmers. Keeping in mind the importance of such a basil chemotype a need to develop a plant type having high essential oil yielding traits along with better linalool content was aimed in this study. A planned breeding and selection process was undertaken at CSIR- CIMAP, Lucknow to develop such a variety of *Ocimum basilicum* and findings are summarized in this report.

ORIGIN OF THE VARIETY

The *Ocimum* germplasm collection and evaluation programme was started in 2002 at CSIR CIMAP, Lucknow which resulted in collection of 189 genetic stocks of 9 species. Subsequent to this an exhaustive breeding work was taken up and number of elite lines were developed which provided the basic materials for further characterization under a CSIR network project (BSC 0203). Using half sib family selection for high oil and high linalool content, 16 genotypes were selected in *O. basilicum* progenies. These 16 genotypes (OBL-1 to OBL - 16) were placed in an Initial Evaluation Trial with one local check (IET; Ent-17, RBD, Rep. 3, plot size, =1.5 m^2). Nine best promising lines in IET namely, OBL-1, OBL-2, OBL-4, OBL-6, OBL-7, OBL-10, OBL-12, OBL-13 and OBL-14 (selected on the basis of herb and oil yield with high linalool type) were placed in a Bench Scale Trial (Bench Scale trial {Entries = 10 (9 + one check), RBD, Reps-3, Plot size = 20 m^2). The best four performing genotypes namely, OBL-1, OBL-2, OBL-12 and OBL-14 along with one check were then advanced to a Pilot Scale Trial (PST, plot size 50 m^2) with check variety. The highest oil and linalool yielding genotype, OBL-1 always maintained its superiority over the check and others entries (Table 1-7; Figures 1-3). The elite strain (OBL-1) is released as an improved variety namely CIM-Surabhi for commercial cultivation.

Statement of distinction/ Breeder's claim

Strain OBL-1 is a medium tall (80.56cm) genotype with dark green leaves and light green colour stem. The strain has the following DUS (distinctiveness, uniformity and stability) characteristics.

1. The strain is morphologically distinct from other *Ocimum basilicum* varieties and clearly identifiable by its broad, medium green leaves (Figure 1).

Table 1: Mean performance of 16 elite selections of *Ocimum basilicum* in Initial Evaluation Trial for three economic traits

Entries	IET**, E=17, RBD, Reps-3, plot size=1.5 m^2		
	Fresh herb yield/plot (g)	Oil Content (%)	Oil yield/plot (g)
OBL-1	759.39	0.73	5.58
OBL-2	692,39	0.55	3.81
OBL-3	384.79	0.55	2.11
OBL-4	475.12	0.53	2.53
OBL-5	391.25	0.43	1.69
OBL-6	544.33	0.52	2.48
OBL-7	344.03	0.61	2.36
OBL-8	356.98	0.62	2.20
OBL-9	347.38	0.53	1.85
OBL-10	523.99	0.52	2.70
OBL-11	523.77	0.53	1.73
OBL-12	645.69	0.52	3.34
OBL-13	590.90	0.60	3.55
OBL-14	705.07	0.55	3.88
OBL-15	301.83	0.53	1.66
OBL-16	383.70	0.58	2.29
Check	256.18	0.57	1.45
CD 5%	53.59	0.072	0.58
CD 1%	72.47	0.097	0.79

**-P<0.01

Table 2: Mean performance of selected entries of *O. basilicum* in Initial Evaluation Trial (IET) with respect to essential oil composition

Entries	IET**, E=17, RBD, Reps-3, plot size=1.5 m^2		
	Linalool content (%)	Linalool acetate (%)	Methyl chevicol (%)
OBL-1	75.07	8.41	0.51
OBL-2	64.67	8.63	2.97
OBL-3	49.78	0.15	2.67
OBL-4	42.73	0.36	3.69
OBL-5	48.57	6.91	1.80
OBL-6	60.03	0.02	3.02
OBL-7	29.24	4.70	6.26
OBL-8	44.18	0.85	18.82
OBL-9	57.18	0.64	8.82
OBL-10	45.94	0.47	0.52
OBL-11	51.20	1.23	22.79
OBL-12	47.72	0.85	1.42
OBL-13	73.72	0.37	1.86
OBL-14	60.60	0.13	0.64
OBL-15	59.53	0.13	1.07
OBL-16	54.83	0.22	2.07
Check	26.75	1.39	20.24
CD 5%	2.32	0.36	3.98
CD 1%	3.13	0.48	5.35

**-P<0.01

Table 3: Mean performance of nine superior selections of *O. basilium* in Bench Scale Evaluation Trial for the three economic traits

Entries	BST**, E=10, RBD, Reps-3, plot size=20.00m2		
	Fresh herb yield/plot (Kg)	Oil Content (%)	Oil yield/plot (Kg)
OBL-1	52.25	0.75	0.395
OBL-2	45.70	0.55	0.254
OBL-4	29.57	0.58	0.171
OBL-6	36.35	0.52	0.187
OBL-7	23.17	0.60	0.139
OBL-10	33.67	0.52	0.173
OBL-12	40.35	0.53	0.217
OBL-13	36.42	0.59	0.215
OBL-14	42.30	0.57	0.242
Check	23.66	0.55	0.130
CD 5%	7,27	0.068	0.057
CD 1%	9.97	0.093	0.078

**-P<0.01

Table 4: Mean performance of selected entries in BST with respect to essential oil composition

Entries	BST**, E=10, RBD, Reps-3, plot size=20.00m^2		
	Linalool content (%)	Linalool acetate (%)	Methyl chevicol (%)
OBL-1	75.73	8.433	0.450
OBL-2	64.57	9.233	4.167
OBL-4	50.73	0.027	4.433
OBL-6	62.67	0.026	4.333
OBL-7	32.00	4.85	7.333
OBL-10	45.33	0.463	0.653
OBL-12	47.20	0.850	1.300
OBL-13	40.42	0.383	2.067
OBL-14	60.53	0.167	0.833
Check	27.27	1.267	16.80
CD 5%	4.395	0.395	1.514
CD 1%	6.021	0.541	2.074

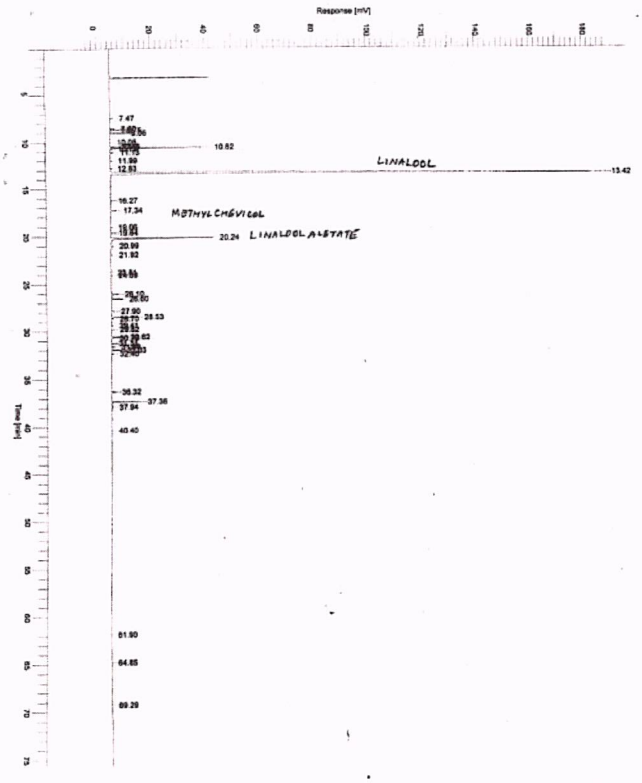
**-P<0.01

Table 5: Mean performance of four elite selections of *O. basilium* in Pilot Scale Trial for the three economic traits

Entries	PST, Entries=5, plot size = 50.00m^2							
	Fresh herb yield/plot (kg)	Fresh herb yield/ha (ql)	Oil Content (%)	Oil yield/plot (Kg)	Oil yield/ha (Kg)	Linalool content (%)	Linalool acetate (%)	Methyl chevicol (%)
OBL-1	110.65	221.30	0.75	0.830	166.00	75.71	8.06	0.44
OBL-2	105.30	210.60	0.60	0.632	126.40	64.11	8.33	0.39
OBL-4	90.80	181.60	0.55	0.499	99.88	52.25	0.03	4.50
OBL-6	95.70	191.40	0.57	0.545	109.00	62.00	0.02	4.00
Check	70.50	141.00	0.50	0.353	70.60	26.04	0.361	24.21

Fig. 1: Field view of Variety CIM-Surabhi a high oil and linalool rich chemotype of *O. basilicum*

2. It has light green stem
3. The strain has a unique advantage of better survival in winter season in comparison to other *O. basilicum* strains/varieties.
4. Essential oil extracted from this strain contain higher linalool content (70-75 %) with low amount of linalool acetate (8.50 %).
5. Strain is also suitable for rain-fed cultivation (March-December)



Peak #	Component Name	Time [min]	Area [uV*sec]	Area [%]
1		7.474	2310.46	0.13
2		8.604	4117.76	0.22
3		8.754	9344.59	0.51
4		9.059	13934.49	0.76
5		10.047	745.08	0.04
6		10.484	5926.53	0.32
7		10.620	88917.20	4.83
8		10.721	1502.93	0.08
9		11.127	3785.62	0.21
10		11.994	1596.62	0.09
11		12.831	862.55	0.05
12		13.416	1394010.43	75.71
13		16.275	1285.46	0.07
14		17.339	8024.68	0.44
15		19.056	938.72	0.05
16		19.636	328.50	0.02
17		20.235	148418.92	8.06
18		20.986	2031.33	0.11
19		21.921	340.14	0.02
20		23.811	70.87	0.00
21		24.086	1047.54	0.06
22		26.096	9184.25	0.50
23		26.603	13295.92	0.72
24		27.897	5005.62	0.27
25		28.535	33157.44	1.80
26		28.695	2272.10	0.12
27		29.415	2003.26	0.11
28		29.825	2678.52	0.15
29		30.623	17362.61	0.94
30		30.723	1897.54	0.10
31		31.310	152.52	0.01
32		31.678	4139.09	0.22
33		32.034	11212.48	0.61
34		32.398	2043.07	0.11
35		36.325	5219.64	0.28
36		37.362	40841.94	2.22
37		37.941	927.55	0.05
38		40.405	170.60	0.01
39		61.903	30.99	0.00
40		64.854	61.51	0.00
41		69.289	90.43	0.00
			1841287.49	100.00

Missing Component Report
Component Expected Retention (Calibration File)

All components were found

Fig. 2: Chromatogram of the essential oil of variety CIM Surabhi indicating the presence of high linalool content.

Table 6: Description and mean performance of the variety CIM-Surabhi

Attributes	CIM-OBL-1	Check
Growth habit	Bushy	Semi spreading
Days to harvest after transplanting	80-85	90-100
Days to flower (50 %)	70-80	85-90
Plant height (cm)	80-85	90-95
Colour of leaf	Medium green	Light green
Length of leaf (cm)	6.20-6.30	5.50-5.60
Width of leaf (cm)	3.40-3.50	1.50-1.55
Fresh herb yield (ql/ha)	221.30	141.00
Oil content in fresh herb (%)*	0.75	0.50
Potential oil yield (kg/ha)**	166.00	70.60
Linalool content (%)	75.71	26.04
Linalool acetate content (%)	8.06	0.361
Methyl chavicol content (%)	0.44	24.21
Oleanolic acid content (%)	0.074	0.021
Ursolic acid content (%)	0.225	0.154

*- Based on oil content data obtained through from Clevenger apparatus;
**- Estimate based on 50 m^2 plot size.

Table 7: Recommended cultivation schedules for the variety CIM-Surabhi

Practics/	Suitable time
Nursery sowing	March first week
Transplanting in field	Last week of March (20-30 days after sowing)
Harvesting for oil	First week of june (80-85 days after transplanting)
Harvesting for seed	Last week of November to first week of December (120 days after transplanting)

Year of development : 2011-2014; Year of release : 2016; Amount of nucleus seed available : 250 gm.

The others distinguishing morphological features and recommended cultivation practices of this variety are given in Tables 6 & 7.

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