Advances in Crop Science and Technology

Woliso et al., Adv Crop Sci Tech 2022, 10:8

Research Article Open Access

Performance of Ethiopian Sweet Basil (*Ocimum bacilicum* L) Genotypes for Agronomic and Chemical Traits in Ethiopia

Woldemariam Geja Woliso[1*], Damtew Abuwey[1], Desta Fikadu[2], Awoqe Bansa[2], Abriham Alemu[2], Bakiri melka[3] and Mihret Mokonin[4]

[1]*Department of Aromatic and Medicinal Plant Breeding, Ethiopian institute agricultural research, Shashemene, Ethiopia*

[2]*Department of Horticultural, Southern Agricultural Research Institute, Hawassa, Ethiopia*

[3]*Department of Chemistry, Ethiopian Institute Agricultural Research, Addis Ababa, Ethiopia*

[4]*Department of Pathology, Wondogenet Agricultural Research Center, Addis Ababa, Ethiopia*

***Corresponding author:** Woldemariam Geja Woliso, Department of Aromatic and Medicinal Plant Breeding, Ethiopian Institute Agricultural Research, Shashemene, EthiopiaTel: 251913455513; E mail: woldegeja@yahoo.com

Received: 15-Oct-2019, **Manuscript No.** ACST-19-3570; **Editor assigned:**18-Oct-2019, **PreQC No.** ACST-19-3570 (PQ); **Reviewed:** 01-Nov-2019, QC No. ACST-19-3570; **Revised:** 03-Aug-2022, QI No. ACST-19-3570 (QI); **Manuscript No.**ACST-19-3570 (R); **Published:** 31-Aug-2022, DOI: 10.4172/2329-8863.1000527

Citation: Woliso WG (2022) Performance of Ethiopian Sweet Basil (*Ocimum bacilicum* L) Genotypes for Agronomic and Chemical Traits in Ethiopia. Adv Crop Sci Tech 10: 527.

Abstract

The study was conducted to determine the herbal and essential oil yields of Ethiopian sweet basil germplasms and to recommend superior varieties. The experiment was consisted six promising genotypes and evaluated in three locations by using randomized complete block design. Data on Agronomic and Chemical Traits was recorded and statistically analyzed by analysis of variance using SAS PROC GLM at P<0.05. Differences between means separated using the least significance difference test at P<0.05. The overall mean performance of six genotypes of Ethiopian sweet basil was statistically significantly affected by genotype, location and year except canopy of the plant. The result indicates that, all the traits were influenced by environment except leaf to stem ratio. The interaction of location and treatment had a highly significant influence on all parameters except fresh stem weight and essential oil content. Therefore; out of the six evaluated accessions, 05 KAM, were verified and released by the breeder Variety designation name of WG-Sweet basil-V for its essential oil production and 02WOL were verified and released by the breeder Variety designation name of WG-Sweet basil-II for its herbal yield production.

Keywords: WG-Sweet basil-II; WG-Sweet basil-V; Wondogenet; Ethiopia; Aromatic plant

Introduction

Basil, a member of the Lamiaceae family is an annual herb which grows in several regions around the world. The white, rose and sometimes violet labiate flowers are in 6-blossomed, pedicled, almost sessile axillary false whorls. The calyx is bilabiate, and the corolla is 4-lobed. The lower lip is simple; the 4 stamens lie on it. The genus Ocimum includes around 30 plant species from tropical and subtropical areas, which are much deferent in respect of morphological and chemical features. The plant probably originated in India, Afghanistan, Pakistan, Northern India and Iran, and now is cultivated worldwide. Traditionally, basil has been extensively [1]. Utilized in food as a flavoring agent, and in perfumery and medical industries. Among the species of the genus, *Ocimum basilicum* L. (sweet basil) is the major essential oil crop around the world, cultivated in many countries. Sweet basil is used as a spicy and medicinal herb, and the aromatic character of each type is determined by genotype and depends on the major chemical compounds of essential oil [2].

The essential oil constituents vary among sweet basil cultivars, and the main ones are linalool, methyl chavicol, eugenol, 1,8-cineole, geranial, neral, methyl cinnamate. The O. basilicum essential oils exhibited a wide and varying array of chemical compounds, depending on variations in chemotypes, leaf and flower colors, aroma and origin of the plants. The chief constituents include chavicol methyl ether or estragole, linalool and eugenol. Basil is a popular herb mainly grown for the fresh market or for its aromatic leaves which are dried and used as a spice or flavoring [3]. It is commercially and extensively cultivated for essential oil production in many continents around the world. It is well known for its numerous economical, medicinal and aromatic values. Medicinally, it is useful in a variety of human and animal diseases treatment such malaria, colic, vomiting, common cold, cough and skin diseases. In Ethiopia, basil is locally known as "Besso bila" in Amharic, "sikakime" or "duguno" in Afan oromo, "seseg" in Tigrigna, "Gimenja" in Hadiya, , "Kepowa" in Wolayita and different Ethiopian ethnic group has different name for sweet basil. Generally sweet basil widely grown as home garden plant throughout the world for its multipurpose use such as medicinal value, flavoring food, spice and blended with different spices for local consumption and its flower is a good source of nectar for the honeybee because of high yield of sugars and long flowering period [4,5].

Thus, it is very needy to explore additional information for proper exploitation of the crop. As many writers and researchers mentioned Ethiopia is a mother of wide agro ecology which makes the country suitable for cultivation of many aromatic and medicinal plant which are traditionally used as medicine and food flavoring spice [6]. Traditionally, basil has been extensively utilized in food as a flavoring agent; however, the variability study among sweet basil genetic resources was not made. Consequently our knowledge on the variability of agronomic and chemical characters that exists in Ethiopia germplasm is limited [7]. This lack of information is the major hindrance to exploit wealth of sweet basil potential in the country. Therefore, to exploit the wealth of sweet basil potential for variety development, the available germplasm should be properly evaluated. Therefore this study was conducted with the objective to determine the variability among sweet basil germplasms of Ethiopia for morpho-agronomic and important quality traits [8].

Materials and Methods

Experimental area

The experiment consisted Six promising genotypes followed from preliminary variety testing of Ethiopian sweet basil that were collected from different parts of Ethiopia [9]. The passport data of the accessions are summarized. They were evaluated nationally by using randomized complete block design in three replications [10]. Planting was done in six 3.6 m × 2.4 m plot area on the commencement of main rainy season with 40cm plant and 60cm row spacing. The planting materials were taken from disease free mother plants maintained at Wondo Genet Agricultural Research Center botanical garden by cutting for seedling preparation [11]. Seedlings were raised in the nursery for 45-60 days in polyethylene bags before being transplanted to the field experimental plots. During experimentation, all nursery and field horticultural practices were performed as required. No fertilizer or chemical is applied during experimentation. Respective spacing of 1.5 m and 1 m was maintained between replications and plots (Table 1) [12].

Testing locations	Latitude	Longitude	Soil pH	Soil type	Rainfall (mm)	Altitude (m.a.sl)	Annual average temperature (°c) minimum maximum
Wondo Genet	7°19' N	38°38' E	6.4	sandy clay loam (Nitosol)	1000	1876	12.02
Arbaminh	50°7N	37°47"E	-	Sandy loam	801	1234	15
Qoqa	80°6' N	38°56'E	6.9	Sandy clay	830.9	1604	13.68

Table1: Summary of site descriptions used for variability testing of Sweet basil (*Ocimum basilicum* L.) germplasm for yield and yield component traits.

During the activity, data on plant height, number of branches/ plant, fresh leaf weight/plant, fresh leaf yield/plot, fresh leaf yield/ hectare, fresh stem weight/plant, fresh stem weight/hectare, fresh leaf to stem ratio/hectare, fresh aboveground biomass/hectare dry leaf weight/hectare dry stem weight/hectare, dry aboveground biomass/hectare number of inflorescence/plant, inflorescence length/plant, canopy spread size/plant, percent essential oil content, essential oil yield/ha was recorded critically [13]. Essential oil content was determined from 300 g of fresh leaves of composite samples harvested from four middle rows of a plot using hydro-distillation in a Clevenger apparatus according to Guenther. Experimental data was statistically Analyzed by Analysis of Variance (ANOVA) using SAS PROC $P<0.05$. Differences between means were assessed using the Least Significance Difference (LSD) test at $P<0.05$ (Table 2).

Accession code	Region/zone	Woreda	Locality	Altitue	Geographical coordinate	Local name
01 wol	SNNPRS?Wolita	Boloso Sore	Dolla	1888	N=06059.353" E=037044'568"	Kepowa/ hiranowa/
02 wol	SNNPRS/Wolita	Damot fulasa	Shanto	1950	N= 07000'878" E=037051' 991"	kepowa
03 had	SNNPRS/Hadiya	East Badewacho	Lalo garbe	1750	N=07005'511" E=037056'647"	Basobila
04 had	SNNPRS/Hadiya	Duna	Somicho	2601	N=07020'781" E=037038'228"	Gim enja
05 kam	SNNPRS/Kambata tambaro	Doyogena	Sarara	2689	N=07019'822" E=037046'816"	Yana
06 won	SNNPRS/ Wondogenet	Wondo genet	Research center	1827	N=07005'35.71" E= 380 7'54.45"	Basobila

Table 2: Passport data for Basil (*Ocimum basilicum*) collection and characterization considered for this particular activity [14].

Results and Discussion

Variation in agronomic and chemical traits of Ethiopian sweet basil

Mean squares from combined analysis of variance for agronomic and chemical traits of 6 accessions of Ethiopian sweet basil tested for three years at three locations of Ethiopia are summarized. The performances of Ethiopian sweet basil accessions were found statistically different (P<0.05) in plant height, number of branches, fresh leaf weight, fresh stem weight, dry leaf weight, dry stem weight, number of inflorescence, inflorescence length, canopy spread size, percent essential oil content and essential oil yield [15]. Over the testing locations plant height/plant, fresh leaf weight/plant, fresh stem weight/plant and inflorescence length/plant were very highly significantly (P<0.001) influenced by location. Moreover, number of branches /plant, canopy spread of a plant were highly significantly (p<0.01) influenced by years. The result indicates that all the traits were influenced by environment except leaf to stem ratio. The interaction of location and treatment had a highly significant influence on all parameters tested except fresh stem weight and percent essential oil content [16]. The overall mean performances of sweet basil accessions for agronomic and chemical characters tested over three locations are summarized in (Table 3).

SV	RP	LOC	TRT	YEAR	LOC*TRT	YEAR*TRT	YEAR*LOC	YE*L*TR	ERROR	CV%
DF	2	2	5	2	10	10	4	20		
PH(cm)	423	4818.46***	210.96***	4474.50***	271.26***	0.00ns	613.50***	0.00ns	37.71	9.69
NBP	4086	22926.43***	1591.27**	2186.00**	3016.88***	0.000ns	122.000ns	0.00ns	464.15	33.33
FLWP(g)	###	190858.31***	48482.22***	6281.062***	83178.071***	358.085ns	2217.21ns	728.39ns	6723	23.39
FLYH(t)	105	367.56***	85.84***	20.55ns	131.88***	1.55ns	8.57ns	1.031ns	9.37	21.56
FSWP(g)	2195	40615.61***	3444.75ns	4369.42***	164.81ns	1067.63ns	127.59ns	0.00ns	1014.1	19.25
FSWH(t)	3.81	70.51**	5.98**	2.13ns	7.59***	0.29ns	1.85ns	0.22ns	1.76	19.51
FLSR(t)	4.21	1.29ns	2.28**	0.22ns	2.13***	0.024ns	0.34ns	0.07ns	0.45	31.62
FAGBH(t)	60.9	655.19***	98.83**	14.35ns	172.66***	1.15ns	349ns	0.96ns	12.56	17.03
DLWH(t)	14.4	13.20***	4.63***	0.42ns	5.20***	0.026ns	0.14ns	0.05ns	0.68	28.65
DSWH(t)	23.7	73.37***	17.05***	1.60ns	16.71***	0.001ns	0.68ns	0.000ns	1.91	33.07
DAGBH(t)	73.1	124.15***	17.88***	3.41ns	31.53***	0.034ns	0.83ns	0.05ns	2.57	22.67
NIF	###	465740.82***	5802.63ns	2333.73ns	25207.21***	0.000ns	2764.21ns	0.000ns	3239	35.49
IFL(cm)	49.4	320.01***	156.96***	184.45***	44.04**	3.41ns	79.00**	3.44ns	17.55	22.51
CS(cm)	1891	1913.29***	43.43ns	279.50**	192.14***	0.000ns	624.50***	0.000ns	40.59	10.68
EOC%w/wd	0.04	0.0774**	0.186***	0.0038ns	0.0115ns	0.0032ns	0.0051ns	0.0027ns	0.011	19.27
EOYH(kg)	248	824.24***	279.007***	19.74ns	219.30***	5.65ns	0.72ns	7.69ns	18.48	27.24

Note: ***: Significant at p<0.001, **: Significant at p<0.01, *: Significant at p<0.05, NS: Non Significant at p>0.05, SOV: Source of Variance, LOC: Location, TRT: Treatment, DF: Degree of Freedom, RP: Replication, CV: Coefficient of Variance, PH(cm): Plant Height, NBP: Number of Branches/Plant, FLWP(g): Fresh Leaf Weight/ Plant, FLYH(t): Fresh Leaf Yield/Hectare, FSWP(g): Fresh Stem Weight/Plant, FSWH(t): Fresh Stem Weight/Hectare, FLSR(t): Fresh Leaf to Stem Ratio/hectare, FAGBH(t): Fresh Aboveground Biomass/Hectare DLWH(t): Dry Leaf Weight/ Hectare DSWH(t): Dry Stem Weight/Hectare, DAGBH(t): Dry Aboveground Biomass/ Hectare NIF: Number of Inflorescence/Plant, IFL(cm): Inflorescence Length/Plant, CS(cm): Canopy Spread Size/Plant, EOC%w/wd: Percent Essential Oil Content, EOYH(kg): Essential Oil Yield/ha

Table 3: Combined analysis of variance for agronomic and chemical traits of Ethiopian sweet basil (*Ocimum basilicum* L.) tested at three locations during the years from 2016 to 2018.

This indicates these traits were influenced by a change in the environment. The significance of location effect was expected because Wondo genet, Arbaminch and Qoqa are vary in their soil type, rainfall and temperature. In agreement to the present study, Fehr reported that every factor that is a part of the environment of a plant has the potential to cause differential performance [17]. Reported that fluctuating features of the location such as rainfall, relative humidity, temperature, etc. are some of the environmental factors that cause performance variation in plants. The influence of location on agronomic and chemical traits were also reported by for lemon verbena, for coriander, indicating the importance of knowing optimum growing locations before intending production of Ethiopian sweet basil [18]. Agronomic characters of Ethiopian sweet basil genotypes. The overall mean performance of six genotypes of Ethiopian sweet basil tested at different locations and years demonstrated statistically different values for all parameters except canopy spread size/plant. The overall mean values of plant height, number of branches/plant, fresh leaf weight/plant, fresh leaf yield/hectare, fresh stem weight/ plant, fresh stem weight/hectare, fresh leaf to stem ratio/hectare, fresh aboveground biomass/hectare dry leaf weight/ hectare dry stem weight/ hectare, dry aboveground biomass/hectare number of inflorescence/ plant, inflorescence length/plant, canopy spread size/plant, percent essential oil content, essential oil yield/ha were 66.70 cm, 63.14, 345.97 g, 14.20 t, 163.19 g, 6.80 t, 2.13 t, 20.82 t, 2.89 t, 4.19 t, 7.07 t, 157.13, 18.61 cm, 59.61 cm, 0.55%, 15.78 kg recorded respectively [19].

Combined over the testing locations, plant height, number of branches/plant, fresh leaf weight/plant, fresh leaf yield/hectare, fresh stem weight/plant, fresh stem weight/hectare, fresh leaf to stem ratio/ hectare, fresh aboveground biomass/hectare dry leaf weight/ hectare dry stem weight/hectare, dry aboveground biomass/hectare number of inflorescence/plant, inflorescence length/plant, canopy spread size/ plant, percent essential oil content, essential oil yield/ha were ranged from 55.39 to 73.79 cm, 41.54 to 81.14, 277.67 to 386.13 g, 11.25 to 16.19 t, 135.71 to 190.56 g, 5.65 to 7.94 t, 2.03 to 2.31t, 16.9 to 23.58 t, 2.32 to 3.21t, 3.46 to 5.53 t , 5.77 to 8.74 t, 98.98 to 267.21 g , 16.54 to 21.29 cm , 53.75 to 65.66 cm, 0.51% to 0.58% and 11.36 to 18.76kg recorded respectively. The highest value was recorded at Arbaminch and the lowest at Wondogenet testing locations except fresh leaf to stem ratio/hectare was highest at Qoqa and number of branches/plant was intermediate at Wondogenet. Considering testing years, statistically different values were recorded in the third testing year for all agronomic characters [20].

A respective percent increase value of 28.01, 20.05, 6.14, 8.85, 4.86, 3.93, 6.03, 5.30, 5.59, 8.54, 17.25, 7.77, 3.70 and 7.09% was recorded in 2010 testing year for plant height, number of branches/plant, fresh leaf weight/plant, fresh leaf yield/hectare, fresh leaf to stem ratio/hectare, fresh aboveground biomass/hectare dry leaf weight/hectare dry stem weight/hectare, dry aboveground biomass/hectare number of inflorescence/plant, inflorescence length/plant, canopy spread size/plant, percent essential oil content, essential oil yield/ha compared with the value obtained in 2008 except 5.16 and 0.58 for fresh stem weight/plant and fresh stem weight/hectare at 2008. In agreement with the present study, a comparable plant height, number of branches/plant, fresh leaf yield/hectare, values ranging from 72 to 98cm, 26.3 to 57.0 and 19.3 t to 19.8 t was reported studied on Herbal and essential oil yield of Genovese basil grown with mineral and organic fertilizer sources in Egypt., who reported aboveground biomass yield ranged from Dry weight of leaves (g/plant) 54.6, dry mass of the total aerial part (g/plant) 121.1 and Plant height (cm) 93.4 for experiment conducted under different basil plants growth and essential oil yield in a production system with successive cuts (Table 4-6) [21].

Treatments	Accessions						Over all Mean	LsD 0.05
	01WOL	02WOL	03HAD	04HAD	05KAM	06WON		
PH(cm)	60.46	68.67	81.74	63.32	62.43	63.59	66.7	2.34
NBP	65.24	70.31	67.78	65.27	60.64	49.58	63.14	8.22
FLWP(g)	338.73	385.4	309.7	283.9	382.57	375.46	345.97	6723.9
FLYH(t)	13.72	15.61	12.92	11.5	15.49	15.95	14.2	9.373
FSWP(g)	165.42	178.99	151.7	164.8	169.47	148.76	163.19	12.15
FSWH(t)	6.87	7.46	6.32	6.87	7.06	6.19	6.8	0.51
FLSR(t)	2.02	2.19	2.05	1.72	2.19	2.61	2.13	0.26
FAGBH(t)	20.61b	23.07	18.87	18.37	22.56	21.41	20.82	1.35
DLWH(t)	2.57	3.02	2.6	2.53	3.01	3.6	2.89	0.32
DSWH(t)	5.28	5.01	3.24	4.02	3.93	3.63	4.19	0.53
DAGBH(t)	7.83	8.03	5.85	6.55	6.94	7.23	7.07	0.61
NIF	159.26	157.53	144.1	146.4	174.43	180.54	157.13	21.72
IFL(cm)	20.93	19.47	15.71	20.29	19.82	15.41	18.61	1.59
CS(cm)	60.52	60.9	59.81	58.52	60.26	57.63	59.61	2.43
EOC%w/wdb	0.59	0.48c	0.45	0.59	0.67	0.53	0.55	0.041
EOYH(kg)	15.45	14.16	11.27	15.14	20.57	18.07	15.78	1.64

Note: Means followed by the same letters with in the same column are statistically non significant at $p<0.05$ according to the Least Significant Difference (LSD) test, PH(cm): Plant Height, NBP: Number of Branches/Plant, FLWP(g): Fresh Leaf Weight/Plant, FLYH(t): Fresh Leaf Yield/Hectare, FSWP(g): Fresh Stem Weight/Plant, FSWH(t): Fresh Stem Weight/Hectare, FLSR(t): Fresh Leaf to Stem ratio/hectare, FAGBH(t): Fresh Aboveground Biomass/Hectare DLWH(t): Dry Leaf Weight/Hectare DSWH(t): Dry Stem Weight/Hectare, DAGBH(t): Dry Aboveground Biomass/Hectare NIF: Number of Inflorescence/Plant, IFL(cm): Inflorescence Length/Plant, CS(cm): Canopy Spread Size/Plant, EOC%w/wdb: Percent Essential Oil Content, EOYH(kg): Essential Oil Yield/ha

Table 4: Combined mean performance of agronomic and chemical traits of Ethiopian sweet basil (*Ocimum basilicum* L.) accessions over the testing locations and years.

Location	Arbaminch	Qoqa	Wondo Genet	Mean	LSD0.05
PH(cm)	73.79	60.88	55.39	63.35	2.34
NBP	81.14	41.54	71.22	64.63	8.22
FLWP(g)	386.13	374.11	277.67	345.97	6723.91
FLYH(t)	16.19	15.15	11.25	14.2	9.373
FSWP(g)	190.56	165.29	135.71	163.85	12.15
FSWH(t)	7.94	6.8	5.65	6.8	0.51
FLSR(t)	2.06a	2.31	2.03	2.13	0.26
FAGBH(t)	23.58	21.96	16.9	20.81	1.35
DLWH(t)	3.21	3.13	2.32	2.89	0.32
DSWH(t)	5.53	3.57	3.46	4.19	0.53
DAGBH(t)	8.74	6.7	5.77	7.07	0.61
NIF	267.21	98.98	114.91	160.37	21.72

IFL(cm)	21.29	16.54	17.99	18.61	1.59
CS(cm)	65.66	59.41	53.75	59.61	2.43
EOC(%w/wd)	0.58	0.57	0.51	0.55	0.041
EOYH(kg)	18.76	17.21	11.36	15.78	1.64

Means followed by the same letters with in the same column are statistically non significant at p<0.05 according to the Least Significant Difference (LSD) test. PH(cm)=Plant Height, NBP=Number of Branches/Plant, FLWP(g)=Fresh Leaf Weight/Plant, FLYH(t)=Fresh Leaf Yield/Hectare, FSWP(g)=Fresh Stem Weight/Plant, FSWH(t)=Fresh Stem Weight/Hectare,FLSR(t)=Fresh Leaf to Stem Ratio/hectare,FAGBH(t)=Fresh AboveGround Biomass/Hectare DLWH(t)=Dry Leaf Weight/ Hectare DSWH(t)=Dry Stem Weight/Hectare, DAGBH(t)=Dry Above Ground Biomass/Hectare NIF=Number of Inflorescence/plant, IFL(cm)=Inflorescence Length/plant, CS(cm)=Canopy Spread size/plant, EOC% w/wdb=percent Essential Oil Content, EOYH(kg)=Essential Oil Yield/ha

Table 5: Combined mean performance of the agronomic and chemical traits of Ethiopian sweet basil (*Ocimum basilicum* L.) accessions under different locations over the three testing years.

Year	2006	2007	2018	Mean	LSD0.05
PH(cm)	57.69	58.52	73.85	63.35	2.34
NBP	59.86	63.19	71.86	64.97	8.22
FLWP(g)	337.37	342.48	358.07	345.97	6723.91
FLYH(t)	13.67	14.06	14.88	14.28	9.373
FSWP(g)	166.29	165.56	157.71	163.19	12.15
FSWH(t)	6.93	6.57	6.89	6.8	0.51
FLSR(t)	2.06	2.18	2.16	2.13	0.26
FAGBH(t)	20.59	20.44	21.4	20.81	1.35
DLWH(t)	2.82	2.86	2.99	2.89	0.32
DSWH(t)	4.15	4.03	4.37	4.18	0.53
DAGBH(t)	6.97	6.89	7.36	7.07	0.61
NIF	153.52	160.96	166.63	160.37	21.72
IFL(cm)	17.68	17.4	20.73	18.6	1.59
CS(cm)	57.55	59.22	62.02	59.6	2.43
EOC (%w/wdb)	0.54	0.55	0.56	0.55	0.041
EOYH (kg)	15.38	15.48	16.47	15.7	1.64

Note: Means followed by the same letters with in the same column are statistically non significant at p<0.05 according to the Least Significant Difference (LSD) test PH(cm): Plant Height, NBP:Number of Branches/plant, FLWP(g)=Fresh Leaf Weight/plant, FLYH(t):Fresh Leaf Yield/hectare, FSWP(g):Fresh Stem Weight/plant, FSWH(t):Fresh Stem Weight/hectare, FLSR(t):Fresh Leaf to Stem Ratio/Hectare, FAGBH(t):Fresh Aboveground Biomass/Hectare DLWH(t):Dry Leaf Weight/Hectare DSWH(t):Dry Stem Weight/Hectare, DAGBH(t):Dry Aboveground Biomass/Hectare NIF:Number of Inflorescence/Plant, IFL(cm):Inflorescence Length/Plant, CS(cm):Canopy Spread Size/Plant, EOC (% w/wdb):Percent Essential Oil Content, EOYH(kg):Essential Oil Yield/ha

Table 6: Combined mean performance of agronomic and chemical traits of Ethiopian sweet basil (*Ocimum basilicum L.*) accessions under different testing years over three testing locations.

Chemical characters of Ethiopian sweet basil

Compared among the tested genotypes, the highest essential oil content and essential oil yield was recorded for 05KAM, 06WON, and 01WOL demonstrating a respective percent increase value of 55.81 and 82.52% on essential oil content and essential oil yield over the lowest value 03HAD. The values for essential oil content and essential oil yield ranged from 0.45 to 0.67% and 11.27 to 20.57 kg/ha, respectively [22]. The overall highest value for essential oil content (0.58%) was recorded at Arbaminch and the lowest value (0.51%) was recorded at Wondo Genet. Averaged over the testing locations, the highest (18.76 kg) essential oil yield/ha was recorded at Arbaminch and the lowest at Wondo Genet (11.36 kg). Compared with first testing year, a respective percent increase value of 3.70 and 7.09% on essential oil content and essential oil yield was demonstrated in third testing year. The oil content of sweet basil in this study (0.45%-0.67%) was similar to several literature reports studied five forms of sweet basils from Germany, Romains, Hungary and Egypt and reported that the oil content varied from 0.1% to 0.55% was showed that the content of essential oil in herb of 10 Italian basil cultivars ranged from 0.3 to 0.8%, reported oil contents in basil herb from 0.38% to 1.29%, while from 0.23% to 1.67%. In a large study on 270 sweet basil accession in Germany, oil content varied from traces to 2.65%. Such variations in the essential oil content of basil across countries might be attributed to the varied agro climatic conditions of the regions. mentioned that climatic factors such as temperature, day length, humidity and rainfall, affected oil content of aromatic plants.

Conclusion

The difference in essential oil content and essential oil yield was due to genotypes and environment. Therefore; out of the six accessions evaluated at national level, 05KAM, were verified and released by the breeder Variety designation (breeder's reference) name of WG-Sweet basil-V for its essential oil production and 02WOL were verified and released by the breeder Variety designation (breeder's reference) name of WG-Sweet basil-II for its herbal yield production based on cultural and current market acceptability, yield potential, genetically stable character and uniformity. Therefore, it is possible to use the two varieties for the production of herbal and essential oil yield in Ethiopia.

Acknowledgement

We would like to acknowledge Medicinal and Aromatic Plants National Program for financial support and Wondo Genet Agricultural Research Centre for providing experimental materials, arranging laboratory facilities and experimental sites for the activity. Mr. Abebe Damise, Mr. Wuqianose Erdachew and Mis. Medihanit issaq are also equally acknowledged for their proper attendance of the activity in managing the field and help in data collection. Mr. Qumneger lingerew is also acknowledged for his help Laboratory analysis of essential oils. Our sincere thanks also go to all who made input for this study.

Cymbopogon citratus

References

1. Aflatuni A (2005) The yield and essential oil content of mint (*Mentha spp.) in Northern Ostrobothnia*. 52.
2. May A, Bovi OA, Maia NB, Barata LES, Souza R, et al. (2008) Basil plants growth and essential oil yield in a production system with successive cuts. Bragantia 67: 385-389.
3. Beemnet M, Getinet A (2010) Variability in Ethiopian coriander for agronomic and quality traits. Afr Crop Sci J 18: 43-49.
4. Beemnet MK, Solomon A, Texeria Da S (2011) Agronomic characters, leaf and essential oil yield of peppermint (*Mentha piperiata* L.) as Influenced by Harvesting Age and Row Spacing. 5: 49-53.
5. Beemnet MK, Solomon A, Zinash T A, Haileslassie G K, Beniyam Y et al. (2011) Performance of lemongrass (*Cymbopogon citratus* L.) (DC) Stapf) for agronomic and chemical traits in different agro-ecologies of Ethiopia. Med Aro Plant Sci Bio 5: 133-138.
6. Beemnet MK, Wondu B, Solomon AM (2013) Performance of Lemon Verbena (*Aloysia triphylla* L.) for morphological, economic and chemical traits in Ethiopia. Am Eurasian J Agric Environ Sci 13: 1576-1581.
7. Bhattacharier (1998) A Hand Book of Medicinal Plants. Pointer Pub 241-242.
8. Chwil M (2007) Flowering pattern, the structure of nectar surface and nectar secretion in two varieties of *Ocimum basilicum L*. Acta Agrobot 60: 55-65.
9. Da-Silva F, Santos RHS, Diniz ER, Barbosa LCA, Casali VWD, et al. (2003) Content and composition of basil essential oil at two different hours in the day and two seasons. Braz J Med Plants 6: 33-38.
10. Desta FE, Woldemariam G, Beemnet M (2017) Agronomic and Bio-chemical Variability of Ethiopian Sweet basil (*Ocimum basilicum* L.) Acad Res J Agric Sci Res 5: 489-508.
11. Fehr W R (1991) Principles of Cultivar Development Theory and Technique 1: 247-260.
12. Hadush Gebrehiwot RK, Bachetti AD (2015) Chemical composition and antimicrobial activities of leaves of sweet basil (*Ocimum basilicum* L.) Herb Int J Basic Clin Pharmacol 4: 1-7.
13. Hussain AI, Anwar F, Sherazi STH, Przybylski R (2008) Chemical composition antioxidant and antimicrobial activities of basil (*Ocimum basilicum)* essentials oils depends on seasonal variations. Food Chem 108: 986-995.
14. Koba K, Poutouli W, Raynaud CH, Chaumont J, Sanda K, et al. (2009) Chemical composition and antimicrobial properties of different basil essential oils chemotypes from Togo. Bangladesh J Pharmacol 4: 1-8.
15. Nurzynska-Wierdak R (2007) Evaluation of morphological and developmental variability and essential oil composition of selected basil cultivars. Herba Pol 53: 255-261.
16. Omidbaigi R, Hassani A, Sefidkon F (2003) Essential oil content and composition of sweet basil (*Ocimum basilicum)* at different irrigation regimes. J Essent Oil-Bear Plants 6: 104-108.
17. Sajjadi SE (2006) Analysis of the essential oils of two cultivated basil (*Ocimum basilicum L.)* from Iran. Daru 14: 128-130.
18. Simon, Morales, Phippen, Vieira and Zao (1999) Basil: A source of aroma compounds and a popular culinary and ornamental herb. 16: 499-505.
19. Singh S, Singh M, Singh A K, Kalra A, Yadav A, et al. (2010) Enhancing productivity of Indian basil (*Ocimum basilicum L.)* through harvest management under rainfed conditions of subtropical north India plains. Ind Crops Prod 32: 601-606.
20. Telci I, Bayram E, Yilmaz G, Avci B (2006) Variability in essential oil composition of Turkish basils (*Ocimum basilicum L.)*. Biochem Syst Ecol 34: 489-497.
21. Vina A, Murillo E (2003) Essential oil composition from twelve varieties of basil (*Ocimum spp)* grown in Colombia. J Braz Chem Soc 14: 744-749.
22. Wesołowska A, D Kosecka, D Jadczak (2012) Essential oil composition of three sweet basil (*Ocimum basilicum L.)* cultivars. 2: 1-12.