5.	Control	23±2

#Mean ± S.E

Table 13: Total fresh weight of *Mentha arvensis*

S.no	Name of the Treatment	Total fresh weight (g) recorded at different percentage levels			
		5%	10%	15%	20%
1.	Onion peel extract	20±2.5	35±3	37±2.8	41±1.2
2.	Potato peel extract	40±2	30±2.1	20±1	37±1.7
3.	*Calatropis* entire plant extract	50±2.6	80±1.5	170±1.5	120±1.5
4.	All (1:1:1)	28±1.9	70±2.2	51±1.8	80±1.6
5.	Control	40±1			

#Mean ± S.E

An increase in total fresh weight (120.6±2.0 g) and total dry weight (52.4±.5 g) in *C. asiatica* with an aqueous extract of *T. diversifolia* (5% concentration) was observed compared to the aqueous extract of *T. purpurea* (20% concentration) (6.7±2.9 g) and (1.7±1.1 g)

(Table 5 & 6). In *M. arvensis* , the aqueous extract of *Calotropis* (15% concentration) increased the total fresh weight (170±1.5g) and shoot length (39±2 cm), whereas the aqueous extract of potato peel (15% concentration) decreased the same (20±1g) and (12±0.6 cm) respectively (Table 12 & 13).

3.1 Soil analysis:

The results are presented in Table 14

Table 14: Soil analysis of *Mentha arvensis*

S.no	Name of the treatment	pH	EC dS/m	Orc C%	N kg/ha	P kg/ha	K kg/ha
1	Control	7.1	0.51	0.38	140	9.65	174
2	Onion peel extract	6.97	0.42	0.38	146	10.36	160
3	Potato peel extract	6.84	0.40	0.41	151	10.52	176
4	*Calotropis* entire plant extract	6.90	0.38	0.42	160	11.21	170

#Mean ± S.E

Figures

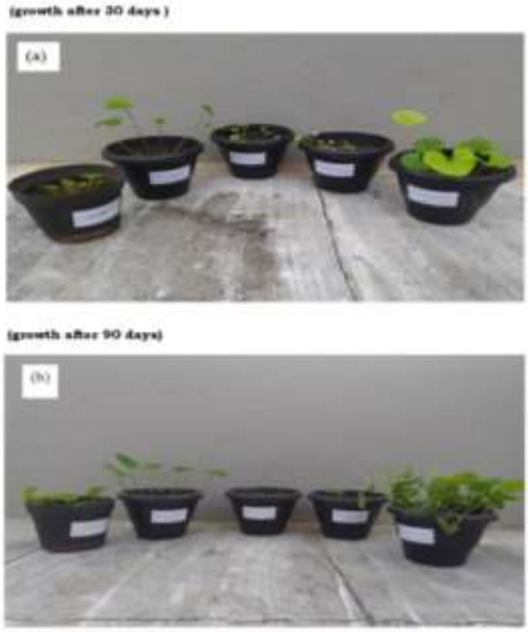

Figure 1 Effect of *T. purpurea* aqueous extract on *Centella asiatica*

Figure 2 Effect of *I.carnea* aqueous extract on *Centella asiatica*

Figure 3 Effect of *T. portulacastrum* aqueous extract on *Centella asiatica*

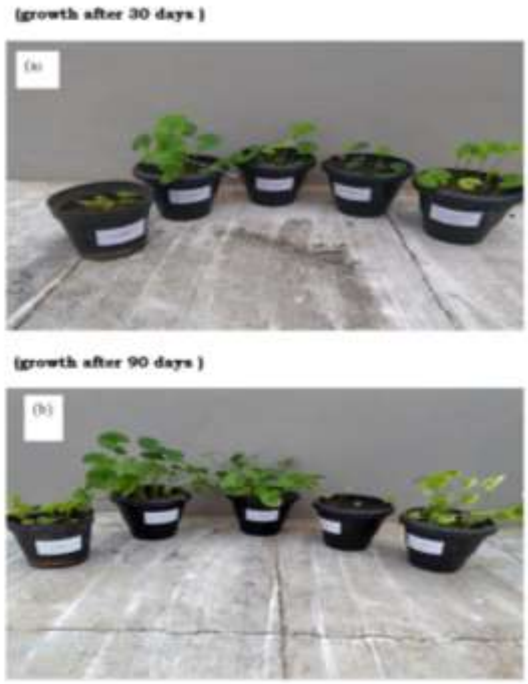

Figure 4 Effect of *T.diversifolia* aqueous extract on *Centella asiatica*

Figure 5 Effect of combination of 2 to 5 (1:1:1:1) aqueous extract on *Centella asiatica*

Figure 6 Treatment of Onion and potato aqueous extract on *Centella asiatica*

Figure 7 Treatment of *C.gigantea* and mixed combination of aqueous extract on *Menta arvensis*

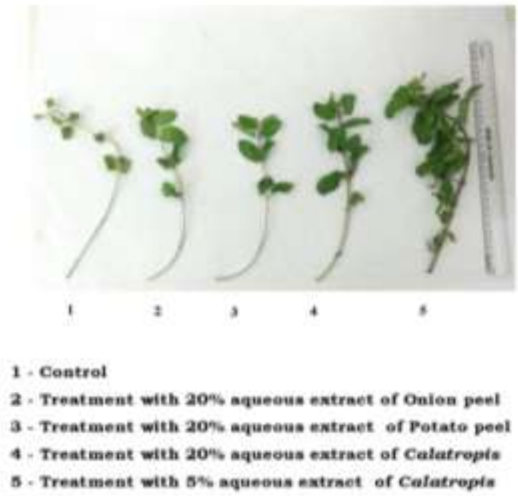

Figure 8 Treatment of Onion and potato peel of aqueous extract on *Menta arvensis*

1 - Control (H_2O)

2 – Treatment with 10% aqoueus extract of *Tephrosiapupurea*

3 - Treatment with 20% aqoueus extract of *Ipomea carnea*

4 - Treatment with 5% aqoueus extract of *Tithonia diversifolia*

Figure 9 Petiole length of *Centella asiatica*

1 – Control (H_2O)

2 - Treatment with *Tephrosia purpurea* aqueous extract (a -10%; b - 50%)

3 - Treatment with *Ipomea carnea* aqueous extract (a -10%; b - 50%)

4 - Treatment with *Trianthema portulacastrum* aqueous extract (a -5%; b - 50%)

5 - Treatment with *Tithonia diversifolia* extract (a -10%; b - 20%)

Figure 10 Root length of *Centella asiatica*

1 - Control (H_2O)

2 - Treatment with *Tephrosia purpurea* (10%) aqueous extract

3 - Treatment with *Ipomea carnea* (20%) aqueous extract

4 - Treatment with *Trianthema portulacastrum* (50%) aqueous extract

5 - Treatment with *Tithonia diversifolia* (5%) aqueous extract

6 – Treatment with combination of 2 to 5 (1:1:1:1) (10%) aqueous extract

Anatomical study in *C. asiatica*

C.S of Petiole

C.S of Leaf

Figure 11 Leaf surface area, anatomical study of petiole and leaf of *Centella asiatica*

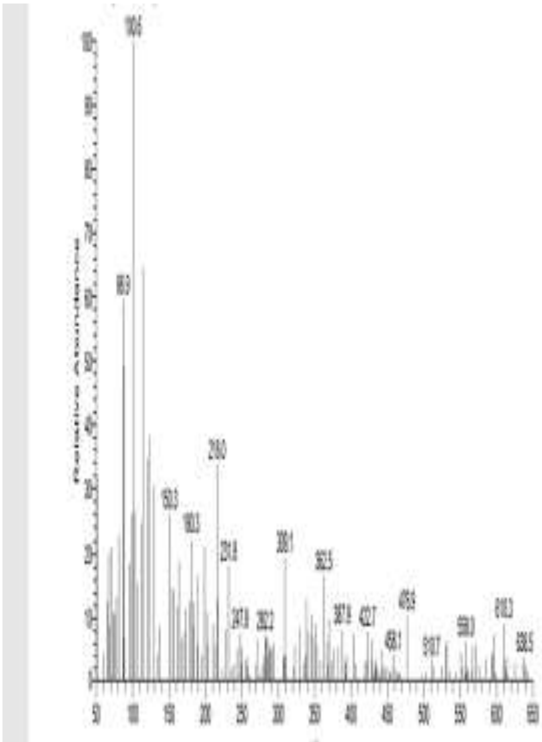

Figure 12 GC-MS analysis of *Mentha arvensis* oil

3.2 GC-MS analysis

In GC-MS analysis 30 bioactive phytochemical components were identified in the hexane extract of *M. arvensis*. Among the identified compound, 5-(4-Hydroxyphenyl) -10,20-bis (3-methoxyphenyl) -15-Propylporphyrin, 5- (deuteriomethyl)- 3-methyl-4- nitroisoxazole were reported as major compounds followed by 5,10-bis(3-aminophenyl)-15,20-diphenylporphyrin,{12,12,17,18,22,23 Hexamethyl2,7 anthraquinono[26,27b] phthalocyanine}zinc,7,8-Dimethoxy-13-carbomethoxy-15-à- (3,4,5-trimethoxybenzoxy)- 13,14 didehydroalloberban, (-)- Asimilobin and {1',2'-bis (Methoxycarbonyl) -1,1,6,7,11,12-hexamethylbenzo [16,17-d] phthalocyanine} zinc.

Table 15: GC-MS analysis of *Mentha arvensis* oil

S. No	RT	Name of the compound	Molecular Formula	Molecular Weight (g/mol)	Peak area
1	4.49	7,8-Dipropyl-2-ethoxycarbonyltetrathia [7]helicene	$C_{31}H_{26}O_2S_4$	558	2.94
2	5.63	2,2-Bis[4-[(4,6-dichloro-1,3,5-triazin-2-yl)oxy]phenyl]-1,1,1,3,3,3-hexafluoropropane	$C_{21}H_8C_{l4}F_6N_6O_2$	630	2.33
3	7.55	5,10-bis(3-aminophenyl) -15,20-diphenylporphyrin	$C_{44}H_{32}N_6$	644	2.64

4	7.85	5H-Cyclopropa [3,4]benz[1,2-e]azulen-5-one, 3,9,9a-tris(acetyloxy) -3-[(acetyloxy)methyl]-2-chloro-1,1a,1b,2,3,4,4a,7a, 7b,8,9,9a-dodecahydro- 4a,7b-dihydroxy- 1,1,6,8-tetramethyl-	$C_{28}H_{37}ClO_{11}$	584	3.07
5	9.36	Oleic acid, 3-(octadecyloxy)propyl ester (CAS)	$C_{39}H_{76}O_3$	592	2.38
6	11.52	13-(3,4,5-trimethoxyphenyl)- ,4,8,11-tetraoxadispiro [4.1.4.3]tetradecane	$C_{19}H_{26}O_7$	366	3.54
7	12.94	5-(4-Hydroxyphenyl)- 0,20-bis(3-methoxyphenyl)- 15- Propylporphyrin	$C_{43}H_{36}N_4O_3$	656	5.79
8	15.17	{12,12,17,18,22,23- Hexamethyl-2,7- anthraquinono[26,27-b] phthalocyanine}zinc	$C_{38}H_{30}N_4O_2Zn$	638	4.31
9	16.29	6,6''-Bis(chloromethyl) [4,4':6',4''-terdibenzofuran]	$C_{38}H_{22}Cl_2O_3$	596	2.56

10	17.51	(RR)/(SS) and (RS)/(SR)-8-(2-chlor-1,2-diphenylethyl)-3,7-dihydro-1,3,7-trimethyl-1H-purin-2,6-dion	$C_{22}H_{21}ClN_4O_2$	408	3.32
11	18.08	Pregnan-20-one, 3,11,21-tris[(trimethylsilyl)oxy]-, O-methyloxime, (3à,5á,11á)-	$C_{31}H_{61}NO_4Si_3$	596.087	3.99
12	18.71	4,4'-(o-Xylylenedithio)bis(5-carbomethoxy-1,3-dithiol-2-one	$C_{18}H_{14}O_6S_6$	518	2.84
13	24.07	8,10-bis(1',1'-Dimethylethyl)-4,6-bis(4'-methylphenyl)-3,7-dithiatricyclo[4.4.0.0(2,8)]deca-4,9-diene	$C_{30}H_{36}S_2$	460	2.61
14	25.41	Norvenlafaxine	$C_{16}H_{25}NO_2$	263.381	3.14

15	26.92	5''-(1,1-Dimethylethyl)-2,2',2'',2''',2''''-pentamethoxy[1,1':3',1'':3'',1''':3'''.1''''-quinquephenyl]-3,3''''-dimethanol	$C_{41}H_{44}O_7$	648.796	3.15
16	27.74	5,11,17,23-Tetra-t-butyl-25,26,27,28-tetrahydroxycalix-4-arene	$C_{44}H_{56}O_4$	648.928	3.18
17	29.33	5,10-bis(3-aminophenyl)-15,20-diphenylporphyrin	$C_{44}H_{32}N_6$	644.782	4.43
18	29.79	7,8-Dimethoxy-13-carbomethoxy-15-à-(3,4,5-trimethoxybenzoxy)-13,14-didehydroalloberban	$C_{31}H_{37}NO_9$	567.635	4.25
19	30.63	5-(Ethynyl)non-1-en-8-yn-5-yl acetate	$C_{13}H_{16}O_2$	204.269	2.91
20	31.06	(-)-Asimilobin	$C_{35}H_{62}O_6$	578.875	4.24

21	31.42	Bicyclo[3.1.1]hept-3-en-2-yl 2,2,2-trifluoromethyl Ether	$C_9H_{11}F_3O$	192.181	2.39
22	32.28	Benzeneacetic acid, 3-methoxy-4-[(trimethylsilyl)oxy]-, trimethylsilyl ester (CAS)	$C_{15}H_{26}O_4Si_2$	326.539	3.52
23	2.58	norepinephrine-pentatms	$C_{23}H_{51}NO_3Si_5$	530.09	2.61
24	34.24	5-(deuteriomethyl)-3-methyl-4-nitroisoxazole	$C_5H_3D_3N_2O_3$	142.06	4.65
25	35.29	{1',2'-bis(Methoxycarbonyl)-1,1,6,7,11,12-hexamethyl benzo[16,17-d] phthalocyanine }zinc	$C_{34}H_{32}N_4O_4$ Zn	626.034	4.21
26	36.33	36,37,38-Trimethoxy-5,10,15-trimethyl-22,25,30,33-tetraoxa-1,19-diazapentacyclo [17.8.8.1(3,7).1(8,12).1(13,17)]octatriaconta-3,5,7(36)nonane	$C_{38}H_{52}N_2O_7$	648.841	2.41

27	36.66	2,7,12,17-tetrabrom-(all-às)cyclotetrathiophen (2,7,12,17-tetrabromcycloocta [1,2-b:4,3-b':5,6 -b'':8,7-b''']tetrathiophen	$C_{16}H_4Br_4S_4$	644.064	2.53
28	39.57	2-Cyclohexylamino-cyclohex-2-en-1-one	$C_{12}H_{19}NO$	193.29	3.11
29	40.27	2,2-Bis[4-[(4,6-dichloro -1,3,5-triazin-2-yl)oxy]phenyl]-1,1,1,3,3,3- hexafluoropropane	$C_{21}H_8Cl_4F_6N_6O_2$	632.125	4.28
30	41.12	4-Bromophenyl)bis (2,4-dibromophenyl)amine	$C_{18}H_{10}Br_5N$	639.805	2.65

Treatment of *C. asiatica* with *Tithonia diversifolia* extract at lower concentration increased the number of leaves, petiole length, leaf surface, root length, and fresh & dry weight. A similar observation was noticed in growth parameters (shoot height, fresh weight, dry weight, leaf area, and ratio) of *Zea mays* treated with fresh stem extract of *Tithonia diversifolia* (Oyerinde *et.al.* 2009). The potentiality of *T. diversifolia* as green manure and organic fertilizer for vegetable crops is already known. Our findings are in accordance with the results of the growth of purple nutsedge recorded by different mango aqueous extracts or powder concomitant with the accumulation of phenolic compounds that might indicate a sort of allelopathic stress (Baloch *et al.* 2014, Kiran & Patra, 2003). In the present study, *T. diversifolia* may contain allelochemicals that perform both stimulatory and inhibitory functions. The stimulatory functions of these chemicals were evident in the significant enhancement of the growth parameters (petiole height, fresh weight, dry weight, and leaf area) of *C. asiatica.*

Treatment of *T. purpurea* at lower concentrations decreased the number of leaves, petiole length, leaf surface, root length, and fresh & dry weight in *Centella asiatica*. Higher concentrations of the extract increased the number of leaves and inhibited the root length. The use of legume green manures is complicated, because of potential problems with phytotoxicity of the residues for several weeks following incorporation into the soil (Liang *et al.* 2006) which would have been a reason for the decreased root length in the present study. Soil containing *Euphorbia hirta* powder showed a significant reduction in the fresh and dry weight of wheat plant (Mojid *et al*. 2012). Treatment of *Centella asiatica* individually with leaf and stem extract of *T. portulacastrum* produced more number of leaves in minimum germination time. The result was contradictory to the germination of rice seeds which was significantly affected by soaking the water extracts of *T. portulacastrum* in distilled water (Mubeen e*t al*. 2011). Maximum germination time (MGT) was found when rice seeds were soaked in root and leaf extracts of *T. portulacastrum*.

In this study highest growth was recorded in a 15% concentration of aqueous extract of *Calotropis*, while the lowest growth was recorded in a 5% aqueous extract of onion peel. This may be due to the release of ammonium-nitrogen through volatilization losses (Solomon *et al*. 2001). Similar reports on the effect of kitchen waste on plant growth and productivity have been studied for tomato in pot experiments by Vanlauwe *et al* (2001). 15% concentration of *Calotropis* aqueous extract increased the total number of leaves, leaf surface area, shoot length and total fresh weight compared to control in *M. arvensis*. This could be attributed to the addition of nitrogen in adequate amounts which results in the enhancement of yield due to a positive effect on plant growth, fresh leaf weight, and root development (Jilani *et al*. 2010).

A 5% concentration of onion peel aqueous extract decreased the total number of leaves, shoot length, and total fresh weight compared to the control. A similar observation was noted in the findings of Resende *et al.*, (1999) in radish. Chlorophyll content (mg/g of fresh weight) was recorded. Treatment of *T. portulacastrum* increased the total chlorophyll content of *C. asiatica* compared to *T. purpurea*. A good and optimum supply of green manure is associated with increased plant growth due to which the plants explore more soil nutrients and moisture. Plant leaf nutrients such as N, P, K, and micronutrients (Ca, Mg, Zn, Cu, Fe & Mn) were rich in the plant extracts when compared to the control. N and K were higher with the treatment of *T. purpurea*, whereas lower with the treatment of *I. carnea*. P was higher with the treatment of *T. portulacastrum*. Micronutrients were most abundant in the treatment with *T. purpurea* on *C. asiatica*. The soil containing aqueous extract of 15% *Calotropis* extract had the highest levels of nitrogen and phosphorus compared to the control. Nitrogenous fertilizers may have a positive impact on soil health (Singh, 2018). Aqueous extract of potato peel (20%) increased potassium when compared to the control. N, P, and K sources are well known to contribute to soil moisture (Garter, 1967; Stevenson & Bates, 1968).

In this study, 0.03ml oil was obtained from *M. arvensis* treated with a 15% concentration of *Calotropis* aqueous extract. *Mentha* retains its nutritional values even after steam distillation and oil extraction and has been reported to have great promise as an organic source of plant nutrients (Chattopadhyay *et al*. 1993, Patra & Singh, 1993, Patra & Anwar, 1997). *Mentha arvensis* essential oil is the main source of natural menthol. The genetic characteristics of the essential oil quality of *Mentha arvensis* are not fully understood (Kumar *et al*., 2000). Only a few genes have been identified and cloned, although several workers are actively involved in the study of the monoterpenoid pathway of *Mentha arvensis* and related mint. Among the identified compound,5- (4-Hydroxyphenyl)-10,20- bis(3-methoxyphenyl) -15 -Propylporphyrin, 5-(deuteriomethyl)-3-methyl-4-nitroisoxazole was found as major compound followed by 5,10-bis(3-aminophenyl)-15,20- diphenylporphyrin, {12,12,17,18,22,23- Hexamethyl-2,7-anthraquinono [26,27-b] phthalocyanine} zinc, 7,8-Dimethoxy-13-carbomethoxy-15-à-(3,4,5-trimethoxybenzoxy)-13,14-didehydroalloberban, (-)- Asimilobin and {1',2'-bis(Methoxycarbonyl)-1,1,6,7,11,12-hexamethylbenzo [16,17-d]phthalocyanine} zinc.

4. Conclusion

In menthol mint, there has been limited work regarding its organic cultivation. Therefore, producing essential oil through organic farming has great importance in the present context. In a mint cropping system, the joint application of organic fertilizer and green manure plays a significant role in sustaining crop productivity and restoring soil fertility (Patra & Anwar, 1997).

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