

Effect of Lime and FYM on the Herb Yield of Mint (*Mentha arvensis*) in an Acid Soil Odisha

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ABSTRACT

A field experiment was conducted in the nursery of the College of Forestry, OUAT, Bhubaneswar to study the effect of lime and FYM applied alone and in different combinations on the yield of *Mentha arvensis*. The experiment was designed in Factorial RBD with nine treatments and three replications. The treatments consist of liming @ 0, 0.3 and 0.5 LR with FYM @ 0, 2.5 and 5.0 ton/ha in different combinations. Results of the experiment revealed that application of lime and FYM significantly increased the plant height; root, leaf and stem weights; leaf, herbage and oil yields. Maximum leaf, herbage and oil yields of 110 q/ha, 318 q/ha and 44 kg/ha, respectively (after 120 days of planting) were obtained with application of lime @0.3LR along with FYM @5 ton/ha. These yields were 157, 122 and 487% higher, respectively, than these in control (0lime +0 FYM). Maximum leaf, herbage and oil yield after 180 days of planting were the highest (84q/ha, 330q/ha and 30 kg/ha, respectively) when lime was applied @ 0.5 LR along with FYM @ 5.0 ton/ha. These yields were 123, 120 and 400% higher, respectively, than those in the control. Application of lime had no effect in increasing the oil content, whereas FYM had a significant effect in increasing the oil content in *M. arvensis*.

Keywords

Mint, Lime, FYM, Medicinal plant.

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Introduction

Mentha arvensis L., popularly known as Japanese mint is an aromatic and medicinal plant that belongs to the Lamiaceae family (Lorenzi and Matos, 2002). It is world's third most valuable flavouring agent (Fenarolics, 1971). Different species of the family Lamiaceae have been cultivated in different parts of the world with major producers of mint are India, China, Vietnam and Brazil (Chand *et al.*, 2004; Clark, 1998; Kumar *et*

al., 2000; Lawrence, 2007; Singh and Saini, 2008). *Mentha* species reproduce both by reproductive and vegetative means. The area under menthol mint is mainly confined to central parts of Indo-Gangatic plains encompassing the northern states of Punjab, Haryana, Uttar Pradesh, Bihar and tarai belt of Uttarakhand (Kumar *et al.*, 2001). The menthol mint (*Mentha arvensis* L.), a potent source of menthol oil has occupied a prime

position in Indian agriculture due to its number of industrial applications. It has emerged as a competent cash crop in north Indian plains in view of high market price for its essential mint oil. India is a leading producer of mint oil, contributing approximately 85% of the total world production (Anwar *et al.*, 2010). In India, it is cultivated on 1.75 lakh ha area with a production of 55000 tonnes (www.business-standard.com). Presently about 75% of the world requirement of menthol crystallized from mint oil is met by India. India exports approximately 25,000 tonnes all forms of menthol oil including crystals. The domestic consumption of India is about 40% of global consumption. Japanese or menthol mint (*Mentha arvensis* L.) is a succulent, multi-cut perennial crop containing 75-85% menthol. Mint oil has wide applications in pharmaceutical, agro-chemicals and flavoring industries (Tassou *et al.*, 2004).

Materials and Methods

The field experiment was conducted in the nursery of the College of Forestry, Orissa University of Agriculture and Technology, Bhubaneswar. The soil of the experimental site was sandy loam with 17.6 % clay. The soil was strongly acidic having the pH of 5.4. Salt pH with 0.01 CaCl₂ was 5.0 positive difference between pH and salt pH indicated that the soil was net negatively charged. Organic carbon content in the soil was low (0.46%). Available N (alkaline KMnO₄ method), P (Brays' I method), K (NH₄OAc) were low (108, 23.5, 14.6kg/ha respectively). Exchangeable Ca²⁺ + Mg²⁺ content in the soil was 1.4 cmol (p+) kg⁻¹. Lime requirement of the soil to the pH 6.5 determined by modified woodruff buffer method, was 2000 kg/ha. The experimental design was factorial RBD with nine treatment and three replications (T₁=0LR+0FYM, T₂=0LR+FYM@2.5t/ha, T₃=0LR + FYM@5t/ha, T₄ =0.3LR +FYM@0

t/ha, T₅=0.3LR+ FYM@2.5t/ha, T₆=0.3LR +FYM@5t/ha, T₇=0.5LR +FYM @ 0t/ha, T₈=0.5LR + FYM @2.5t/ha, T₉=0.5LR +FYM @5t/ha.). The source of lime was paper mill sludge having 68% CaCO₃ equivalent. Constant dose of N, P₂O₅ and K₂O were applied @ 80, 40, 40 kg/ha, through urea, DAP and muriate of potash, respectively. Required quantities of PMS and FYM were applied during land preparation. After 4 days, mint suckers were planted. Disease free healthy suckers of mint were cut into pieces of 7-10 cm lengths and planted to a depth of 5 to 7cm with a row to row spacing of 35 cm. One third of N and full dose of P and K were applied after 10 days of planting with full establishment of suckers. Rest 2/3rd of N was applied of 22 days of planting after the 1st weeding. Prior to conducting the experiment, were collected after 120 and 180 days of planting and were analysed.

Results and Discussion

Plant height at 120 day was the lowest (54cm) in control (zero lime and zero FYM). It increased significantly with application of lime and FYM. The highest plant height of 82.2cm was recorded in the treatment receiving lime@0.3LR and FYM@5ton/ha. At a given level of LR, plant height increased with increasing levels of FYM added and at a given levels of FYM, it increased with increasing levels of lime added.

Plant height at 180 day was the effect lime, FYM and their interactions had significant effects on the plant height. The highest plant height recorded in T-9 (0.5LR + FYM@5t/ha) was statistically at par with T-6 (0.3LR + FYM@5t/ha) but significantly superior to all other treatments. Chlorophyll content at 120 day was the lowest of 0.93mg/g leaf in control and increased significantly due to application of lime with the highest value of 1.57 mg/g in T-6 (0.3LR + FYM @5t/ha).

Table.1 Effect of lime and FYM on plant height in *M. arvensis* at 120days of planting

Level of Lime / FYM	Plant height(cm)			
	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN
0LR	53.97	61.17	68.85	61.66
0.3LR	61.75	64.83	82.22	69.6
0.5LR	69.1	70.1	79.83	73.01
MEAN	61.61	65.37	77.73	68.09
CD(P=0.05)	LR=3.38**	FYM=3.38**	LRxFYM=NS	
S.E.(m)±	1.12	1.12	1.95	
CV(%)	4.97			

Table.2 Effect of lime and FYM on stem fresh weight and stem dry weight of *M. arvensis* at 120 days of planting

Level of Lime / FYM	Stem fresh weight (g/plant)				Stem dry weight (g/plant)			
	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN
0LR	64.45	70.56	98.34	77.78	19.51	21.42	27.35	22.76
0.3LR	94.09	95.27	137.23	108.86	25.69	27.63	52.3	35.21
0.5LR	102.57	133.22	135.55	123.78	34.66	43.22	50.89	42.93
MEAN	87.04	99.68	123.71	103.48	26.62	30.76	43.52	33.63
CD (P=0.05)	LR=5.01**	FYM=3.68*	LRxFYM=8.68**		LR=3.68**	FYM=3.68**	LRxFYM=3.68**	
S.E.(m)±	1.67	1.67	2.89		1.23	1.23	2.13	
CV(%)	4.84					10.95		

Table.3 Effect of lime and FYM on leaf fresh weight and leaf dry weight of *M. arvensis* at 120 days of planting

Level of Lime / FYM	leaf fresh weight (g/plant)				Leaf dry weight (g/plant)			
	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN
0LR	31.17	37.65	53.69	40.83	11.60	15.71	22.68	16.66
0.3LR	47.69	51.43	84.21	61.11	16.08	16.9	25.28	19.42
0.5LR	43.44	64.78	73.33	60.52	16.50	21.18	25.12	20.93
MEAN	40.76	51.29	70.41	54.51	14.73	17.93	24.36	19.00
CD (P=0.05)	LR=5.44**	FYM=5.44*	LRxFYM=9.43**		LR=1.80**	FYM=1.80**	LRxFYM=NS	
S.E.(m)±	1.81	1.81	3.14		0.60	0.60	1.04	
CV(%)	10.05					9.48		

Table.4 Effect of lime and FYM on root fresh weight and root dry weight of *M. arvensis* at 120 days of planting

Level of Lime FYM	Root fresh weight (g/plant)				Root dry weight (g/plant)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
OLR	45.74	53.52	82.5	60.59	15.73	20.63	28.39	21.58
0.3LR	76.48	98.56	146.05	107.03	28.09	37.72	49.71	38.51
0.5LR	94.50	129.71	143.57	122.59	42.97	44.26	47.26	44.83
MEAN	72.24	93.93	124.04	96.74	28.93	34.21	41.79	34.97
CD(P=0.05)	LR=5.16**	FYM=5.16**	LRxFYM=8.93**		LR=3.86**	FYM=3.86**	LRxFYM=6.69**	
S.E.(m)±	1.72	1.72	2.98		1.82	1.82	2.23	
CV(%)	5.34				11.06			

Table.5 Effect of lime and FYM on chlorophyll content in the leaves of *M. arvensis* at 120 days of planting

Level of Lime FYM	Chlorophyll(mg/g)			
	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN
OLR	0.93	1.35	1.50	1.26
0.3LR	1.45	1.47	1.57	1.50
0.5LR	1.22	1.34	1.47	1.34
MEAN	1.20	1.39	1.51	1.37
CD(P=0.05)	LR=0.11**	FYM=0.11**	LRxFYM=0.19**	
S.E.(m)±	0.03	0.03	0.06	
CV(%)	8.20			

Table.6 Effect of lime and FYM on Leaf yield and Herbage yield of *M. arvensis* at 120 days of planting

Level of Lime FYM	Leaf yield (kg/ha)				Herbage yield (kg/ha)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
OLR	4644.44	5537.90	8031.16	6071.17	14261.96	16011.83	22723.18	17665.66
0.3LR	7274.80	7654.09	11918.59	8949.16	21454.54	21850.84	31827.86	25044.41
0.5LR	6447.49	9498.33	10843.83	8930.22	21758.74	29282.37	30938.73	27326.61
MEAN	6447.50	7563.77	10264.53	7983.52	19158.41	22381.68	28496.59	23345.56
CD(P=0.05)	LR=631.51**	FYM=631.51**	LRxFYM=1093.81**		LR=910.70**	FYM=910.70**	LRxFYM=1577.37**	
S.E.(m)±	210.64	210.64	364.85		303.76	303.76	526.14	
CV(%)	7.92				3.90			

Table.7 Effect of lime and FYM on Oil content and oil yield of *M. arvensis* at 120 days of planting

Level of Lime FYM	%Oil content				Oil yield (kg/ha)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
OLR	0.13	0.27	0.37	0.26	7.52	18.32	29.61	18.48
0.3LR	0.27	0.3	0.4	0.32	14.55	20.57	43.98	26.36
0.5LR	0.27	0.23	0.33	0.28	12.89	31.25	39.37	27.84
MEAN	0.22	0.27	0.37	0.29	11.65	23.38	37.65	24.23
CD(P=0.05)	LR=NS	FYM=008**	LRxFYM=NS		LR=5.00**	FYM=5.00*	LRxFYM=NS	
S.E.(m)±	0.02	0.02	0.04		1.67	1.67	2.89	
CV(%)	28.53					20		

Table.8 Effect of lime and FYM on plant height in *M. arvensis* at 180 days of planting

Level of Lime FYM	Plant height(cm)			
	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN
OLR	50.97	51.9	61.1	54.66
0.3LR	56.02	64.95	77.07	66.01
0.5LR	69.7	73.25	80.2	74.38
MEAN	58.90	63.37	73.79	65.06
CD(P=0.05)	LR=3.09**	FYM=3.09**	LRxFYM=5.36*	
S.E.(m)±	1.03	1.03	1.78	
CV(%)	4.76			

Table.9 Effect of lime and FYM on stem fresh weight and stem dry weight of *M. arvensis* at 180 days of planting

Level of Lime FYM	Stem fresh weight (g/plant)				Stem dry weight (g/plant)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
OLR	55.16	64.07	73.41	64.21	20.44	23.37	30.34	24.72
0.3LR	88.42	96.14	132.29	105.62	29.73	31.56	44.67	35.32
0.5LR	123.87	133.81	164.67	140.74	32.82	44.24	56.63	44.56
MEAN	89.09	98.01	123.45	103.52	27.66	33.06	43.88	34.87
CD(P=0.05)	LR=5.46**	FYM=5.46*	LR x FYM=9.46**		LR=4.44**	FYM=4.44*	LR x FYM=NS	
S.E.(m)±	2.58	2.58	3.16		1.48	1.48	2.57	
CV(%)	5.28					12.74		

Table.10 Effect of lime and FYM on leaf fresh weight and leaf dry weight of *M. arvensis* at 180 days of planting

Level of Lime / FYM	leaf fresh weight (g/plant)				Leaf dry weight (g/plant)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
0LR	24.66	29.66	37.34	30.55	7.29	8.42	9.47	8.39
0.3LR	31.33	38.18	43.06	37.52	9.45	11.11	14.51	11.69
0.5LR	36.51	43.45	56.29	45.41	11.32	14.19	19.06	14.85
MEAN	30.83	37.1	45.56	37.80	9.35	11.24	14.34	11.67
CD (P=0.05)	LR=3.67**	FYM=3.67*	LRxFYM=NS		LR=0.88**	FYM=0.88**	LRxFYM=1.52**	
S.E.(m)±	1.22	1.22	2.11		0.29	0.29	0.51	
CV(%)	9.71					7.5		

Table.11 Effect of lime and FYM on root fresh weight and root dry weight of *M. arvensis* at 180 days of planting

Level of Lime / FYM	Root fresh weight (g/plant)				Root dry weight (g/plant)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
0LR	62.25	71.12	86.25	73.21	22.32	30.83	23.28	25.48
0.3LR	85.85	99.19	104.27	96.44	35.85	46.83	59.9	47.53
0.5LR	135.71	157.21	152	148.31	54.17	62.75	62.32	59.75
MEAN	94.60	109.17	114.17	109.84	37.45	46.80	48.5	45.36
CD (P=0.05)	LR=3.57**	FYM=3.57**	LRxFYM=6.18**		LR=3.21**	FYM=3.21**	LRxFYM=5.56**	
S.E.(m)±	1.19	1.19	2.06		1.07	1.07	1.86	
CV(%)	3.25					7.08		

Table.12 Effect of lime and FYM on chlorophyll content in the leaves of *M. arvensis* at 180 days of planting

Level of Lime / FYM	Chlorophyll(mg/g)			
	0FYM	FYM@2.5t/ha	FYM@5t/ha	MEAN
0LR	0.7	1.16	1.47	1.11
0.3LR	1.41	1.36	1.58	1.45
0.5LR	1.38	1.22	1.51	1.37
MEAN	1.17	1.25	1.52	1.31
CD(P=0.05)	LR=0.081**	FYM=0.081**	LRxFYM=0.141**	
S.E.(m)±	0.02	0.02	0.04	
CV(%)	6.23			

Table.13 Effect of lime and FYM on Leaf yield and Herbage yield of *M. arvensis* at 180 days of planting

Level of Lime FYM	Leaf yield (kg/ha)				Herbage yield (kg/ha)			
	0FYM	FYM@ 2.5t/ha	FYM@5t /ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
0LR	3779.81	4447.22	5485.50	4570.84	12133.63	14051.1	16363.69	14182.81
0.3LR	4732.60	5569.61	6237.51	5513.24	17910.11	19850.10	26063.68	21274.63
0.5LR	5309.67	6499.41	8415.30	6741.45	23699.24	26554.05	33013.05	27755.45
MEAN	4607.36	5505.41	6712.76	5608.51	17914.33	20151.75	25146.81	21070.96
CD (P=0.05)	LR=495.32*	FYM=495.32**	LRxFYM=NS		LR=2022.64**	FYM=2022.64**	LRxFYM=NS	
S.E.(m)±	1.18	1.18	2.04		674.67	674.67	1168.54	
CV(%)	8.84					9.61		

Table.14 Effect of lime and FYM on Oil content and oil yield of *M. arvensis* at 180 days of planting

Level of Lime FYM	% Oil content				Oil yield(kg/ha)			
	0FYM	FYM@ 2.5t/ha	FYM@5t/ha	MEAN	0FYM	FYM@ 2.5t/ha	FYM@ 5t/ha	MEAN
0LR	0.167	0.333	0.367	0.289	5.93	14.76	20.25	13.65
0.3LR	0.2	0.267	0.367	0.278	9.47	15.11	23.14	15.90
0.5LR	0.2	0.333	0.4	0.311	10.62	21.48	30.17	20.75
MEAN	0.189	0.311	0.378	0.293	8.67	17.12	24.52	16.76
CD (P=0.05)	LR=N	FYM=0.050**	LRxFYM=N		LR=3.53**	FYM=3.53**	LRxFYM=NS	
S.E.(m)±	0.02	0.02	0.03		1.18	1.18	2.04	
CV(%)	16.93					21.07		

Table.15 Correlation coefficient values among different plant parameters at 120 days of planting

	PLANT HEIGHT	STEM FRESH WEIGHT	STEM DRY WEIGHT	LEAF FRESH WEIGHT	LEAF DRY WEIGHT	ROOT FRESH WEIGHT	ROOT DRY WEIGHT	LEAF YIELD	HERBAGE YIELD	% OIL CONTENT	OIL YIELD	CHLOROPHYLL
PLANT HEIGHT		0.91**	0.93**	0.93**	0.94**	0.92**	0.88**	0.93**	0.93**	0.81**	0.91**	0.69*
STEM FRESH WEIGHT			0.96**	0.94**	0.88**	0.98**	0.93**	0.95**	0.99**	0.59	0.86**	0.60
STEM DRY WEIGHT				0.93**	0.85**	0.97**	0.92**	0.93**	0.96**	0.56	0.86**	0.50
LEAF FRESH WEIGHT					0.93**	0.95**	0.84**	1.00**	0.97**	0.73	0.95**	0.71*
LEAF DRY WEIGHT.						0.86**	0.75*	0.93**	0.91**	0.83**	0.97**	0.75*
ROOT FRESH WEIGHT							0.96**	0.95**	0.98**	0.61	0.86**	0.60
ROOT DRY WEIGHT								0.84**	0.91**	0.58	0.72*	0.55
LEAF YIELD									0.97**	0.73*	0.95**	0.71*
HERBAGE YIELD										0.65	0.90**	0.65
% OIL CONTENT											0.77*	0.90**
OIL YIELD												0.73*
CHLOROPHYLL												

n=9, df =7, r=0.67 at 5% level, r=0.80=at 15 level. *= Significant at 5% level **= Significant at 5% level

Table.16 Correlation coefficient values among different plant parameter 180 days of planting

	PLANT HEIGHT	STEM FRESH WEIGHT	STEM DRY WEIGHT	LEAFFRESH H WEIGHT	LEAF DRY WEIGHT	ROOT FRESH WEIGHT	ROOT DRY WEIGHT	LEAF YIELD	HERBAGE YIELD	% OIL CONTENT	OIL YIELD	CHLORO PHYLL
PLANT HEIGHT		0.96**	0.94**	0.92**	0.93**	0.96**	0.96**	0.90**	0.96**	0.57	0.79*	0.65
STEM FRESH WEIGHT			0.95**	0.91**	0.96**	0.96**	0.96**	0.90**	1.00**	0.47	0.72*	0.61
STEM DRY WEIGHT				0.97**	0.99**	0.90**	0.89**	0.97**	0.97**	0.66	0.87**	0.62
LEAFFRESH WEIGHT					0.97**	0.84**	0.85**	1.00**	0.94**	0.72*	0.92**	0.67*
LEAF DRY WEIGHT.						0.89**	0.89**	0.97**	0.98**	0.63	0.86**	0.59
ROOT FRESH WEIGHT							0.98**	0.83**	0.95**	0.46	0.68	0.55
ROOT DRY WEIGHT								0.84**	0.95**	0.48	0.70*	0.62
LEAF YIELD									0.94**	0.72*	0.91**	0.63
HERBAGE YIELD										0.52	0.77*	0.62
% OIL CONTENT											0.93**	0.56
OIL YIELD												0.62
CHLOROPHYL												

n=9, df =7, r=0.67 at 5% level, r=0.80=at 15 level. *= Significant at 5% level **= Significant at 5% level

At a given of lime applied chlorophyll content increased with increasing levels of FYM added. At a given level of FYM chlorophyll content increased upto 0.3LR level and decreased at 0.5LR level. Effect of lime and FYM and their interaction on chlorophyll content was significant. The highest chlorophyll content in T-6 (0.3LR + FYM@5t/ha) was statistically at par with that in T-9 (0.5LR + FYM@5t/ha) but was significantly superior to all other treatments. Chlorophyll content at 180 day was the lowest (0.7 gm/g) in the control and increased significantly with application of lime and FYM. The highest chlorophyll content of 1.58mg/g was recorded in T-6 (0.3LR + FYM@5 ton/ha). The highest chlorophyll content in T-6 was statistically at par with T-9 (0.5LR + FYM@5ton/ha) but significantly superior to other treatments.

Values of all the growth parameters as well as leaf, herbage and oil yields and % oil content were the highest with application of lime@0.3LR along with FYM@5ton/ha at 120 days of planting. The leaf, herbage and oil yields in this treatment was 119.18 q/ha, 318.27q/ha and 43.98kg/ha, respectively as against the leaf, herbage and oil yields of 46.44q/ha, 142.61q/ha and 7.52kg/ha in control (0LR+0FYM). At 180 days of planting, different growth parameters like plant height, weights of root, stem and leaf/plant, leaf, herbage yield, % oil content and oil yield were the highest with application of lime@0.5LR along with FYM@5ton/ha. The leaf, herbage and oil yield in this treatment were 84.2q/ha, 33.0q/ha and 30.2kg/ha, respectively as against the leaf, herbage and oil yields of 37.8q/ha, 121.3q/ha and 5.9kg/ha, respectively in control. All the growth parameters data recorded on mint plant has been presented in table 1-14.

Significant positive correlation existed among different growth parameters both at 120 and

180 days of planting (Table 15 and 16). Plant height, dry and fresh weights of stems, leaves, leaf and herbage yield and oil yield possessed highly significant positive correlation with the dry and fresh root weights. This indicated that the plant growth in *M. arvensis* was significantly related to the root growth in soil. Dry and fresh weight of leaves, leaf and herbage yields and oil yield were positively correlated with plant height. Oil yield was positively correlated with the leaf and herbage yields. Positive correlation existed between % oil content and oil yield in *Mentha arvensis*. Positive relationship of % oil content with plant height, stem fresh and dry weight, leaf fresh and dry weight was obtained only at 120 days of planting. A highly significant positive correlation was obtained between the chlorophyll content and percent oil content at 120 days of planting.

The leaf, herbage and oil yields in *Mentha arvensis* increased significantly with application of lime and FYM.

Maximum leaf, herbage and oil yields in the 1st harvesting (i.e. after 120 days of planting) were obtained with application of lime@0.3LR and FYM@5t/ha, whereas these yields at those in the second harvesting (i.e. after 60 days of 1st harvesting) were the maximum when lime was applied @0.5LR with FYM@5.0t/ha. The lowest yields were obtained when no lime and FYM were added. Application of lime had no effect in increasing the oil content in plant, whereas FYM had a significant effect in increasing the oil content in *M. arvensis*.

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