

## EFFECT OF ORGANIC MANURES AND CHEMICAL FERTILIZERS ON *FOENICULUM VULGARE*, MILL AND *CARUM CARVI*, L.

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تم دراسة تأثير التسميد العضوي والكيماوي على النمو الخضري ومحصول الزيت ومكوناته لنباتى الشمر والكرابيه فقد استخدمت ثلاثة تركيزات من كل سماد وهى سماد الماشيه بمعدل م<sup>3</sup>/فدان ، م<sup>3</sup>/فدان وسماد الدواجن بمعدل م<sup>3</sup>/فدان ، م<sup>3</sup>/فدان وخليط من السمادين (الماشيه + الدواجن) بمعدل م<sup>3</sup>/فدان + م<sup>3</sup>/فدان + م<sup>3</sup>/فدان. وتم اضافة تلك الاسمدة للتربه وقت التحضير. اما بالنسبه للتسميد الكيماوي فقد تم رشه على التربه مرتين بعد يومين من الزراعه.

اسفرت النتائج عن ان استعمال سماد الماشيه بمعدل م<sup>3</sup>/فدان اعطت افضل القياسات على النمو الخضري وكذا على انتاج الثمار /فدان فى النباتين موضوع الدراسه. واعطت قيمه عاليه لكل من النيتروجين، الفسفور والبوتاسيوم فى الاوراق لنبات الشمر. اعلى انتاجيه للزيوت لثمار الشمر نتجت عن استعمال خليط سماد الماشيه والدواجن بمعدل م<sup>3</sup>/فدان + م<sup>3</sup>/فدان بالنسبه لثمار الكرابيه نتجت عن استعمال سماد الدواجن بمعدل م<sup>3</sup>/فدان وهذا التركيز ايضا اعطى اعلى قيمه لكل من النيتروجين ، الفسفور والبوتاسيوم.

*The effect of organic manures and chemical fertilizers on the vegetative growth and oil production and composition for both plants were studied. The experiments were carried out during two seasons of 2001/2002 and 2002/2003.*

*Three concentration from each of farmyard manure, FYM (8,12 and 16 m<sup>3</sup>/fed), chicken manure, CM (0.8, 1.2 and 1.6 m<sup>3</sup>/fed) and*

*mixed manures of FYM + CM (4 + 0.4, 6 + 0.6 and 8 + 0.8 m<sup>3</sup>/fed) were added at the time of soil preparation. The chemical fertilizers N and K were used as soil dressing two times after 50 and 75 days from planting.*

*The results indicated that the use of FYM, 16 m<sup>3</sup>/fed treatment produced high vegetative growth and high fruit yield/fed in both plants as well as high values of NPK for fennel plant.*

*The high oil yield was produced from the use of the mixed treatment FYM + CM 4 + 0.4 m<sup>3</sup>/fed and by the use of CM, 1.2 m<sup>3</sup>/fed in case of fennel and caraway plants respectively. The dose of CM, 1.2 m<sup>3</sup>/fed with caraway also produce high values of NPK.*

## INTRODUCTION

*Foeniculum vulgare*, Mill (Fennel) and *Carum carvi*, L. (Caraway), Apiaceae family, are important medicinal and aromatic plants.<sup>1</sup> They are used as popular flavoring agents in culinary preparations, bread, pastry and confectionery.<sup>2</sup>

Fennel volatile oil is commonly used as antimicrobial, galactagogue, for estrogenic activities and as a remedy for jaundice and menstrual troubles. Fennel plant occupies a high position in exportation list of medicinal plants.<sup>3-6</sup>

Caraway fruits are traditionally used as a remedy for dyspepsia, intestinal colic and antispasmodic.<sup>7&8</sup>

It was reported that the use of organic fertilizers as chicken, poultry, farmyard or cattle manures increased the vegetative growth as well as the contents of several aromatic plants.<sup>9-16</sup>

This investigation was conducted us to study the effect of application of organic manures and chemical Fertilizers on the vegetative growth of *Foeniculum vulgare*, Mill and *Carum*

*carvi*, L. plants as well as on oil yield and composition of their fruits.

## MATERIAL AND METHODS

This study was carried out during the period 2001-2003 in two successive seasons at the Farm of Medicinal and Aromatic Plants, Gemmiza (A.R.C.) Gharbieah Governorate.

The fruits of *Foeniculim vulgare*, Mill and *Carum Carvi*, L were sown on November 15<sup>th</sup> in the first season and November 1<sup>st</sup> in the second one.

The organic manures used were three doses of each of farmyard manure (FYM) 8, 12 and 16 m<sup>3</sup>/fed., chicken manure (CM) 0.8, 1.2 and 1.6 m<sup>3</sup>/fed. and mixed manures (FYM + CM) 4 + 0.4, 6 + 0.6, 8 + 0.8 m<sup>3</sup>/fed.

Before planting the calculated amount of organic manures and calcium superphosphate were added at the time of soil preparation. Chemical fertilizers (N in the form of ammonium sulphate 130 kg/fed and k as potassium sulphate 100 kg/fed)

were added also with calcium superphosphate as soil dressing after 50 and 75 days from planting. The experiments were designed in a complete randomize blocks with three replicates.

Control treatment was used without any addition. The plant height (cm), number of branches and umbles/ plant, plant fresh weight (g), umbles dry weight (g), weight of 100 fruits (g), weight of fruits yield/plant (g) and /fed. (Ton) were recorded at the full blooming of both plants.

The percentage of N, P and K elements were determined according to the literature procedures.<sup>17-19</sup> Volatile oils content of the fruits were determined by water distillation method<sup>20</sup> and GLC analysed using Hewlett Packard 5890 with flame ionization detection that was fitted with capillary column, coated with carbowax 20 M x 0.2 min. The operating conditions were injector temperature 250°, detector temperature 300°. Nitrogen was used as a carrier gas with flow rate 1 ml/min, for hydrogen was 30 ml/min. and for air was 300 ml/min. The peaks were recorded and the areas under peaks were determined using HP-integrator. Series II apparatus. The oil components were identified by comparing their retention time to that of the authentic compounds.

The mean values of the treatments were compared by L.S.D. test

according to Snedecor and Cochran.<sup>21</sup>

## RESULTS AND DISCUSSION

The data in Tables (1 and 2) showed that all fertilization treatments significantly increased all the vegetative parameters for fennel plant in comparing with the control group for both seasons.

The highest values were noticed in both seasons with 16 m<sup>3</sup>/fed FYM treatments for all parameters except with number of umbles/plant and the weight of 100 fruits. The two latter parameters showed indicative values with the mixed manures FYM + CM at 4 : 0.4 and 8 : 0.8 m<sup>3</sup>/fed respectively in both seasons. Our results were in accordance with the findings of Mohamed and Ahmed,<sup>9</sup> Migahed and El-Kased<sup>22</sup> and Abd-El-Salam.<sup>23</sup>

The recorded data in Table (3) indicated that the volatile oils content in fennel fruits were increased as a result of fertilization during the two experimental seasons. The most pronounced effect resulted from the mixed manures FYM + CM at the concentration ratio of 4 + 0.4 m<sup>2</sup>/fed. The increase in volatile oil content was probably due to the increment in the metabolic activities. These results were in agreement with those of Jacoub<sup>13</sup> on thyme and Aly<sup>24</sup> on fennel.

**Table 1:** Effect of fertilizaion treatments on the vegetative growth of *Foeniculum vulgare*, Mill in the first season 2001/2002.

Treatments m <sup>3</sup> /fed	Effect on							
	Plant height “cm”	No. of branches/ plant	Plant fresh weight (g)	No. of umbels/ plant	Weight of umbels/ plant (g)	Weight of 100 fruits (g)	Fruits weight/ plant (g)	Fruit yield/fed. (ton)
Control	116.67	9.50	516.67	38.8	87.3	0.86	37.58	0.563
FYM, 8	127.00	14.33	520.67	52.3	132.0	0.89	59.50	0.892
12	135.00	14.17	591.33	39.0	122.3	0.93	53.00	0.783
16	186.67	14.77	881.67	39.2	162.0	1.03	117.53	1.763
CM, 0.8	184.33	12.83	662.17	48.2	112.7	0.97	81.27	1.219
1.2	144.67	14.50	689.0	52.5	142.0	1.01	103.00	1.545
1.6	157.67	13.33	813.33	36.2	152.0	0.89	110.27	1.654
FYM + CM, 4 + 0.4	158.33	14.3	729.17	56.2	135.3	0.90	98.18	1.473
6 + 0.6	163.33	11.17	745.0	45.8	132.7	0.92	68.92	1.034
8 + 0.8	135.17	12.83	735.83	47.2	137.7	1.07	99.88	1.498
NPK	170.33	11.17	795.83	42.3	114.0	1.00	82.71	1.241
L.S.D. (5%)	6.51	1.99	15.43	4.89	36.42	0.139	10.32	0.069
L.S.D. (1%)	8.85	2.67	17.93	6.05	41.73	0.189	14.71	0.094

**Table 2:** Effect of Fertilizaion treatments on the vegetative growth of *Foeniculum vulgare*, Mill in the second season 2002/2003.

Treatments (m <sup>3</sup> /fed)	Effect on							
	Plant height “cm”	No. of branches/ plant	Plant fresh weight (g)	No. of umbels/ plant	Weight of mbels/ plant (g)	Weight of 100 fruits (g)	Fruits weight/ plant (g)	Fruit yield/fed. (ton)
Control	161.33	8.50	478.43	34.7	97.8	1.12	42.67	0.640
FYM, 8	190.17	12.67	695.42	50.7	174.7	1.14	113.68	1.705
12	167.17	11.50	675.75	50.0	142.3	1.22	105.12	1.577
16	195.89	11.87	1087.10	81.5	198.7	1.29	146.41	2.196
CM, 0.8	194.50	11.03	896.67	71.5	188.5	0.98	123.33	1.850
1.2	190.50	11.83	808.33	77.5	161.3	1.14	126.97	1.905
1.6	188.50	11.25	963.75	67.2	193.5	1.20	142.71	2.141
FYM + CM, 4 + 0.4	190.00	11.50	956.67	87.0	182.9	1.18	134.58	2.019
6 + 0.6	181.50	10.17	773.33	66.7	190.0	1.25	140.49	2.108
8 + 0.8	169.17	11.33	733.33	67.7	182.2	1.34	134.57	2.019
NPK	187.83	12.00	949.50	86.0	191.0	1.27	141.23	2.119
L.S.D. (5)	4.40	1.75	56.96	4.66	44.88	0.34	5.39	0.225
L.S.D. (1%)	5.98	2.34	68.43	6.11	53.76	0.46	8.62	0.303

**Table 3:** Effect of fertilization treatments on volatile oil percentage, oil yield/plant and oil yield/feddan of *Foeniculum vulgare*, Mill fruits during the two seasons of 2001/2002 and 2002/2003.

Treatments (m <sup>3</sup> /fed)	First seasons 2001/2002			Second seasons 2002/2003		
	Oil %	Oil yield/ Plant (ml)	Oil yield/ fed. (L)	Oil %	Oil yield/ plant (ml)	Oil yield/ fed. (L)
Control	1.00	0.38	5.65	1.10	0.47	7.05
FYM, 8	1.22	0.73	10.90	1.38	1.57	23.55
12	2.80	0.44	6.60	2.69	2.20	32.95
16	1.66	1.95	29.25	1.54	2.25	33.80
CM, 0.8	1.40	1.13	17.00	1.50	1.85	27.75
1.2	1.68	1.73	25.95	1.76	2.24	33.55
1.6	2.00	2.21	33.10	1.92	2.74	41.10
FYM + CM, 4 + 0.4	2.88	2.63	39.45	2.80	3.66	56.55
6 + 0.6	1.96	1.35	20.25	1.62	2.28	34.15
8 + 0.8	1.69	1.69	25.30	1.86	2.51	37.60
NPK	2.68	2.22	33.25	2.44	3.45	51.70
L.S.D. (5%)	0.346	0.396	2.21	0.219	0.99	2.11
L.S.D. (1%)	0.491	0.544	3.40	0.372	1.33	2.26

GLC analysis of the volatile oil fruits samples during the second seasons Table (4) indicated that  $\alpha$ -pinene, limonene, linalool, methyl chavicol and anethol were identified in all treatments. These results were in agreement with the results obtained by Guenther<sup>2</sup> and Sakr<sup>14</sup> on mentha and Mohsen<sup>26</sup> on sweet basil.

Methyl chavicol was the main component in all the tested treatments as it showed the highest values in relation to the other components. The highest percentage of methyl chavicol was obtained from CM 1.6 m<sup>3</sup>/fed treatment NPK was the most effective treatments on the linalool and anethol content for all the tested oils. The highest values of  $\alpha$ -pinene were

observed with the mixed treatment of 6 + 0.6 m<sup>3</sup>/fed FYM + CM, while that of limonene were noticed at FYM, 8 m<sup>3</sup>/fed.

The effect of fertilization treatments on nitrogen, phosphorous and potassium percentage of fennel leaves in the two experimental seasons are presented in Table (5). The highest level of both N and P were observed with FYM at 16 m<sup>3</sup>/fed treatment, while CM, 0.8 m<sup>3</sup>/fed treatment showed the highest K percentage.

As regard the effect of fertilization treatments on the vegetative growth of caraway during both seasons, it is

**Table 4:** Effect of different fertilization treatments on the percentage of volatile oil components of *Foeniculum vulgare*, Mill fruits during the second season of 2002/2003.

No	Retention time	Identification	% of components in the treatments (m <sup>3</sup> /fed)										NPK
			Control	FYM			CM			FYM + CM			
				8	12	16	0.8	1.2	1.6	4 + 0.4	6 + 0.6	8 + 0.8	
1	3.295	α-pinene	0.679	0.999	0.683	0.454	0.454	0.813	0.476	0.580	1.279	0.377	0.483
2	3.709	Unknown	0.111	---	0.1036	---	---	---	0.168	0.256	---	0.252	---
3	4.200	Fenchone	---	1.202	0.785	---	---	---	---	0.194	---	---	1.53
4	4.573	Unknown	0.491	---	0.218	---	---	---	---	---	---	---	---
5	5.529	Unknown	0.354	---	---	---	---	---	---	0.141	---	---	---
6	5.972	Limonene	10.722	12.794	8.714	7.818	6.841	6.068	7.711	7.030	7.803	5.752	4.074
7	6.257	Unknown	0.469	0.495	0.455	---	---	---	---	---	0.178	0.412	1.216
8	8.967	Linalool	2.991	1.521	2.711	4.772	4.739	3.343	3.208	3.614	3.048	4.374	4.822
9	15.754	Methyl chavicol	79.353	80.285	82.216	82.866	83.274	83.077	85.057	84.913	83.065	84.144	81.927
10	16.671	Unknown	1.870	---	0.195	0.710	0.366	1.067	0.781	0.709	1.641	0.372	0.166
11	19.351	Anethol	2.346	1.658	0.587	0.891	0.813	2.613	0.574	1.502	1.988	0.420	2.691
12	27.801	Unknown	0.246	0.186	0.656	1.152	0.932	0.185	---	0.232	---	0.905	0.017
13	29.004	Unknown	0.176	0.369	---	0.206	0.644	0.492	1.241	0.720	0.410	0.106	0.028

**Table 5:** Effect of fertilization treatments on N, P and K percentage of *Foeniculum vulgare*, Mill leaves during the two seasons of 2001/2002 and 2002/2003.

Treatments (m <sup>3</sup> /fed)	First seasons 2001/2002			Second seasons 2002/2003		
	N%	P%	K%	N%	P%	K%
Control	1.89	0.16	1.4	1.81	0.12	0.9
FYM, 8	1.83	0.19	1.3	2.04	0.16	1.4
12	3.70	0.35	3.3	3.09	0.35	2.4
16	3.64	0.28	1.9	3.03	0.27	2.0
CM, 0.8	3.42	0.22	3.4	2.46	0.2	2.5
1.2	2.81	0.18	1.44	2.39	0.19	2.0
1.6	2.57	0.22	1.2	2.85	0.2	1.7
FYM + CM, 4 + 0.4	3.46	0.29	2.3	2.68	0.29	2.3
6 + 0.6	2.43	0.19	1.2	2.03	0.2	1.2
8 + 0.8	2.12	0.2	1.4	2.7	0.25	1.9
NPK	2.28	0.28	1.9	2.36	0.22	1.8

tabulated in Tables (6 and 7). The results indicated that all the treatments were increased the studied vegetative parameters. Farmyard manure was the most effective treatment when applied at the rate of 16 m<sup>3</sup>/fed. Our results were in accordance with the findings of Fiad<sup>26</sup> on caraway, Aly *et al.*<sup>27</sup> and Abd El-Kader<sup>28</sup> on coriander and anise.

Table (8) clearly showed that the volatile oils percentage and yields were significantly increased with the application of different fertilization treatments. In all cases supplying plants with CM at 1.2 m<sup>3</sup>/fed gave significantly higher oil percentage and yield in both seasons. The previous results were agreed with those obtained by Abd El-Salam,<sup>23</sup> Hammam<sup>29</sup> and Abd El-Wahab<sup>30</sup> on fennel, anise and nigella.

Carvone, limonene and  $\alpha$ -pinene were noticed in all treatments of the GLC volatile oil analysis of the samples taken from the second season Table (9). The table also clearly indicated that carvone was the main component of caraway oil and the highest percent of it was obtained from the mixed manures FYM + CM, 4 + 0.4 m<sup>3</sup>/fed while the lowest percentage was obtained from FYM, 12 m<sup>3</sup>/fed treatments. Limonene was the second component of the oil, it was observed in high percentage by the NPK treatment. This treatment also showed higher percentage of  $\alpha$ -pinene which exhibited relatively small percentage in the oil.

Our results were in agreement with those of Khattab and Omer.<sup>31</sup>

The effect of fertilization treatments on the NPK in the leaves of caraway is presented in Table (10).



**Table 6:** Effect of fertilizaion treatments on the vegetative growth of *Carum carvi*, L. in the first season 2001/2002.

Treatments (m <sup>3</sup> /fed)	Effect on							
	Plant height “cm”	No. of branches/ plant	Plant fresh weight (g)	No. of umbels/ plant	Weight of mbels/ plant (g)	Weight of 100 fruits (g)	Fruits weight/ plant (g)	Fruit yield/fed. (ton)
Control	101.67	9.00	319.0	47.33	70.67	0.576	48.67	0.584
FYM, 8	112.17	10.50	355.33	80.83	90.67	0.561	63.50	0.762
12	110.00	9.50	550.0	66.67	104.00	0.578	73.67	0.884
16	121.67	11.67	658.33	131.00	134.33	1.073	99.33	1.192
CM, 0.8	116.67	11.00	401.67	82.88	80.50	0.572	58.00	0.695
1.2	112.67	10.00	371.67	56.67	126.17	0.614	92.00	1.104
1.6	111.00	11.00	341.0	72.67	89.17	0.627	67.67	0.812
FYM + CM, 4 + 0.4	112.67	8.50	450.00	78.83	92.67	0.749	69.33	0.832
6 + 0.6	106.67	10.00	323.33	66.50	71.00	0.634	55.33	0.664
8 + 0.8	115.00	9.17	463.33	81.33	76.67	0.645	54.67	0.656
NPK	116.00	9.67	296.67	75.17	80.00	0.699	55.00	0.660
L.S.D. (5%)	8.09	1.17	30.98	9.38	12.92	0.073	9.11	0.086
L.S.D. (1%)	11.01	1.59	41.89	12.75	17.56	0.134	12.37	0.123

**Table 7:** Effect of fertilizaion treatments on the vegetative growth of *Carum carvi*, L. in the second season 2002/2003.

Treatments (m <sup>3</sup> /fed)	Effect on							
	Plant height "cm"	No. of branches/ plant	Plant fresh weight (g)	No. of umbels/ plant	Weight of mbels/ plant (g)	Weight of 100 fruits (g)	Fruits weight/ plant (g)	Fruit yield/fed. (ton)
Control	117.33	10.83	325.0	52.17	74.00	0.632	54.88	0.658
FYM, 8	124.83	10.50	365.33	85.17	95.70	0.805	69.13	0.829
12	122.90	10.57	564.67	68.33	108.60	1.219	79.1	0.949
16	134.83	12.50	676.0	136.72	139.33	1.274	105.7	1.268
CM, 0.8	122.67	11.17	406.83	85.17	86.50	0.843	62.17	0.758
1.2	125.67	10.33	386.00	61.67	132.07	1.094	97.23	1.166
1.6	129.83	10.83	347.00	77.00	91.58	0.981	82.23	0.986
FYM + CM, 4 + 0.4	125.00	11.73	442.20	79.83	92.92	0.815	72.43	0.869
6 + 0.6	129.50	10.67	332.82	74.17	102.23	0.779	54.67	0.656
8 + 0.8	125.00	10.50	483.83	84.00	82.95	0.967	58.4	0.701
NPK	122.83	10.33	356.5	79.89	87.33	0.788	60.63	0.727
L.S.D. (5%)	8.07	1.55	26.340	11.14	14.84	0.236	8.65	0.271
L.S.D. (1%)	10.97	2.11	35.646	15.14	20.17	0.287	12.47	0.373

**Table 8:** Effect of fertilization treatments on volatile oil percentage, oil yield/plant and oil yield/feddan of *Carum carvi*, L. fruits during the two seasons of 2001/2002 and 2002/2003.

Treatments (m <sup>3</sup> /fed)	First seasons 2001/2002			Second seasons 2002/2003		
	Oil %	Oil yield/ plant (ml)	Oil yield/ fed. (L)	Oil %	Oil yield/ plant (ml)	Oil yield/ fed. (L)
Control	1.10	0.54	6.44	1.20	0.66	7.92
FYM, 8	2.24	1.42	17.04	2.08	1.44	17.24
12	2.10	1.55	18.56	1.92	1.52	18.24
16	2.48	2.46	29.56	2.12	2.24	26.92
CM, 0.8	1.96	1.14	13.68	2.00	1.26	15.16
1.2	3.00	2.54	30.48	2.80	2.43	29.16
1.6	2.88	1.95	23.4	2.66	2.19	26.32
FYM + CM, 4 + 0.4	1.50	1.04	15.52	1.78	1.29	15.48
6 + 0.6	2.50	1.38	16.64	2.22	1.21	14.56
8 + 0.8	2.20	1.20	14.44	1.94	1.13	13.6
NPK	2.76	1.65	19.8	2.75	1.61	19.28
L.S.D. (5%)	0.37	0.163	2.77	0.31	0.199	3.21
L.S.D. (1%)	0.48	0.223	2.96	0.42	0.277	3.54

**Table 9:** Effect of different fertilization treatments on the volatile oil components of *Carum carvi*, *L.* fruits during the second season of 2002/2003.

No	Retention time	Identification	% of the identified components in treatments m <sup>3</sup> /fed										NPK
			Control	FYM			CM			FYM + CM			
				8	12	16	0.8	1.2	1.6	4 + 0.4	6 + 0.6	8 + 0.8	
1	3.895	$\alpha$ -pinene	0.268	0.227	0.276	0.269	0.282	1.188	0.236	0.244	0.222	0.237	0.374
2	5.455	Limonene	19.274	19.427	23.783	18.274	18.437	16.824	20.141	15.843	17.330	20.807	26.187
3	6.303	Unknown	0.685	0.733	0.333	1.012	0.905	---	---	0.445	---	0.460	---
4	9.841	Unknown	0.397	0.615	0.614	0.619	0.343	0.495	0.451	0.496	0.335	0.366	---
5	11.970	Unknown	---	---	0.059	---	0.087	---	---	0.075	0.054	0.060	0.060
6	14.463	Unknown	0.537	0.653	0.520	0.545	0.540	0.412	0.485	0.473	0.420	0.528	0.471
7	18.463	Carvone	77.811	77.945	71.652	78.462	79.083	81.745	77.992	82.220	81.353	79.945	72.035
8	23.292	Unknown	---	---	0.053	0.037	---	---	---	---	---	---	---
9	24.673	Unknown	0.140	0.189	---	0.130	0.107	0.065	0.139	---	0.064	0.109	0.125
10	28.732	Unknown	0.097	0.138	0.748	---	---	0.098	0.051	---	0.088	---	---

**Table 10:** Effect of fertilization treatment on n, p and k percentage of *Carum carvi*, L. leaves during the two seasons of 2001/2002 and 2002/2003.

Treatments m <sup>3</sup> /fed	First seasons 2001/2002			Second seasons 2002/2003		
	N%	P%	K%	N%	P%	K%
Control	2.09	0.19	2.0	2.27	0.25	2.4
FYM, 8	2.20	0.30	4.02	2.73	0.32	4.5
12	2.30	0.24	3.9	2.20	0.22	3.6
16	3.63	0.32	4.8	2.73	0.27	4.4
CM, 0.8	3.39	0.33	4.7	3.20	0.31	4.5
1.2	3.84	0.37	4.9	3.98	0.33	4.6
1.6	3.10	0.25	3.1	3.76	0.30	3.8
FYM + CM, 4 + 0.4	2.80	0.30	3.7	3.43	0.32	3.9
6 + 0.6	3.46	0.23	3.1	3.18	0.28	3.6
8 + 0.8	3.30	0.25	3.2	3.93	0.28	3.8
NPK	3.13	0.30	4.7	2.68	0.28	4.2

CM, 1.2 m<sup>3</sup>/fed treatment was the most effective one, as it showed higher percentage of NPK content.

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