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EFFECT OF CUTTING PERIOD ON THE YIELD AND CHEMICAL CONSTITUENTS OF DILL

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ABSTRACT

This study was carried out in two seasons to determine the proper time for cutting dill plants. Plants height, fresh and thy nights/plant, number of inflorescences as well as fruit yield/plant and green besides fruit yields/m^2 were recorded. The concentration of proteins, carbohydrates and essential oils as well as its components in herb and fruits were estimated in all collected samples. It appeared that cutting dill plants at 75 days from sowing (for the 1st cut) and 45 days after the first cut (for the 2nd cut) gave the highest herb and fruit yields with best quality.

Introduction

Dill *Anethum graveolens* Linn, family Umbelliferae, is used as flavouring agent, spasmolytic (Muraveove, 1978), bactericidal (Chienols, 1954), fungicidal and fungistatic (Vilianove and Casanovas, 1953). Dill contains essential oils which are official in the BPC and may be used as a substitute for some umbehferous oils (Muraveove, 1978). The essential oils were analysed by GLC (Chaudhary *et al,* 1957) and by polarographic methods (Bitter, 1950). In addition, dill contains Provitamin A (Pospisilove *et al,* 1958), vitamin C which is higher in spring than in summer (Abdullov & Lantsevit, 1958) and ascorbic acid (Grigoriyants *et al,* 1959). The stage of plants development at which the crop should be harvested is one of the most important matter the grower has to decide and should be given careful consideration. The composition of the green plants as well as fruits change more or less with the progress towards maturity. It was reported that the highest content of ascorbic acid observed in dill plants of two weeks old, and carotenes at the flowering time, while the nutritive substances and essential oils coincided with the ovary formation (Sharikova *et al.,* 1973). So, it is essential to judge the right time for cutting dill as its quantity and quality are influenced by crop maturity. This reason motivated the authors to study the effect of cutting date on the green and fruit yields as well as the chemical composition of dill plants and fruits to determine the proper time for cutting dill for herb and fruit production.

Material and Methods

Fruits of dill were sown on 21st November 1981 and 15th November 1982, at the experimental farm of the faculty of Agriculture, Kafr El-Sheikh, Egypt. Commercial regional variety fruits were mixed with sand and broadcasted by hand in plots of 2x2.5 m, in the rate of 10 kg/feddan. Randomized complete block design with twelve replicates in the first cut and three replicates in the second cut was used.

The experimental locations were clay loam in texture, poor in organic matter (2.3%), available phosphorus 20.2 ppm, K 20 ppm, pH 8.2 and T.S.S. in surface layers (0.20 cm) ranged from 11-16%. The normal culture practices for growing dill was followed.

First cut was taken at 45, 60, 75 or 90 days from sowing to determine the best cutting date for the first cut according to green yield capacity and its chemical constituents. At the cutting of 90 days from sowing, all the plants were in the flowering stage, and so this treatment was excluded. Due to the superiority of cutting at 75 days from sowing, this treatment divided into four treatments with three replicates for each one with the aim to determine the best cutting date for the second cut. The four cutting dates of the second cut were 15, 30, 45 or 60 days from the rust one.

In both cuts, the plant height (cm), fresh and dry weights (g/plant) and green yield (g/plot) were determined. After the second cut, dill plants were left to obtain the fruits. The number of inflorescences per plant and fruit yield in gm per plant and m were recorded at maturity. Proteins, carbohydrates as well as the essential oils concentrations were estimated in both cuts, and thereafter in fruits on dry matter basis.

The chemical analysis were carried out according to Weichselgram, 1946 and Balbaa, 1976 for proteins and carbohydrates, respectively. The essential oil was analysed by GLC (Karawya *et al*., 1980) using Varian 3700 dual flame ionization detector under the following conditions: D.T. 300°C, injector temp. 220°C, column temp. 180-190°C, 4°C/min, column package: 20% PEGA on chromosorb w mesh, column length 6 feet with internal diameter 1/4 inch, carrier gas (He) rate 20 ml/min, air flow rate 200 ml/min. and chart street 1 cm/min.

All the data were analyzed statistically according to the procedure outlined by Snedecor and Cochran, 1969.

Results and Discussion

It is apparent from the results in Table-1 (A & B) that in both seasons plant height, fresh and dry weights/plant as well as green yield/plot increased significantly as the time between sowing and first cut or between clippings was extended presumably due to

longer growing period. It is of importance to point out that after 90 days from sowing and 60 days from the first cut most of the plants were in the flowering stage. Thus, there appears to have no reason to extend the 1st cut that 75 days after sowing and the second cut more than 45 days from the first one, for optimum production and best green yield quality.

Table-1 revealed that fruit production drastically decreased as the time between the two clippings was extended. It can be concluded that late cutting coincided with unsuitable climatic conditions for growing of new plants, and consequently the production of weak plants of low fruit yield. Moreover, the lower fruit yield with late cutting also was due to the shorter growth seasons which gave less opportunity for fruits to develop fully.

Table 1

Effect of cutting date on growth and yield of dill plants.

Variables	Date of 1st Cut) (Days ater sowing) 45	60	75	90	L.S.D 5%	Date of 2nd Cut) (Days after 1st Cut) 15	30	45	60	L.S.D 5%
A-First season, 1981-1982										
Plant height (cm)	11.00	20.50	33.33	69.33	6.46	9.33	36.40	62.53	77.06	1.81
Fresh weight/plant (gm)	0.85	3.73	8.10	13.00	2.11	0.56	2.40	6.35	10.20	1.07
Dry weight/plant (gm)	0.17	0.67	1.90	2.95	0.37	0.10	0.51	1.67	2.55	0.21
Green yield/plot (kg)	2.53	5.21	15.23	27.48	0.60	0.98	2.73	9.20	13.74	0.25
No. of inflorescences/ plant	-	-	-	-	-	21.00	13.00	7.00	5.00	1.00
Fruit yield/plant (gm)	-	-	-	-	-	3.00	2.41	1.77	0.75	0.92
Fruit yield /m^2 (gm)	-	-	-	-	-	307.80	247.51	187.00	81.97	5.01
B-Second season 1982-83										
Plant height (cm)	15.83	28.33	44.33	77.00	3.60	15.75	47.23	75.30	93.33	5.82
Fresh weight/plant (gm)	0.69	1.67	6.85	11.70	0.53	0.52	1.90	4.59	9.00	0.97
Dry weight/plant (gm)	0.15	0.31	1.90	3.00	0.10	0.11	0.43	0.98	1.97	0.11
Green yield /plot (kg)	1.77	3.11	12.62	25.74	0.77	1.29	2.87	8.60	16.87	0.16
No. of inflorescences/ plant	-	-	-	-	-	7.80	10.90	6.60	3.20	3.10
Fruit yield/plant (gm)	-	-	-	-	-	2.58	1.92	1.24	0.30	0.43
Fruit yield/m^2 (gm)	-	-	-	-	-	269.00	207.10	131.97	39.90	9.71

The calculated percentages of proteins, carbohydrates and volatile oils in herb and fruits are tabulated in Tables-2 and 3. From these tables, it was clear that the proteins percentage, in the shoots and fruits decreased with advancing age. Such decreases in shoot N-percent may be mainly due to the great increase in the production of plant material, while the decrease in fruits N-percent could be attributed to the weakness of the plants grown after the second cut. This result was in agreement with that reported by Semple and Vicent-Chandler, 1959 who indicated that the protein concentration decreased when intervals between cutting were extended.

Table 2

Proteins, carbohydrates and volatile oils percentages in shoot system of dill plants as affected by cutting date (average of two seasons)

Variables	Date of 1st cut (days after sowing)				L.S.D.	Date of 2nd cut (days after 1st cut)				L.S.D.
	45	60	75	90	5%	15	30	45	60	5%
1.Proteins,%	1.24	0.90	0.80	0.23	0.94	0.68	0.45	0.40	0.22	0.42
2.Carbohydrates,%	1.96	3.60	5.60	7.40	5.32	7.50	5.80	5.50	5.30	2.15
3.Volatile oils,%	0.89	1.35	2.42	1.49	1.44	0.93	1.10	2.26	1.60	1.31

Table 3

The effect of cutting date on the chemical composition of dill fruits (average of two seasons).

Variables	Date of 2nd cut (days after 1st cut)				L.S.D.
	15	30	45	60	5%
1.Proteins, %	4.87	4.63	2.84	2.10	N.S.
2.Carbohydrates,%	1.52	1.28	1.84	0.90	0.57
3.Volatile oils,%	1.11	1.34	1.56	1.20	0.44

Carbohydrates were calculated as soluble carbohydrates.

Regarding the carbohydrate percentage, it was increased with increasing the plant age in the first cut. While in the second cut it decreased in both plants and fruits with extending cutting intervals. This may be attributed to the suitability of climatic conditions

during this period, while a reverse situation was happening during the time between the 1st and 2nd cuts. It can be concluded also that increasing intervals between cuttings (1st and 2nd cuts) resulted in weak plants containing low concentration of carbohydrates, and consequently the amount of carbohydrates translocated to the developing fruits was very small. So, the fruits of this treatment contained low concentration of carbohydrates. Moreover, it is important to point out that the lower concentration of carbohydrates in fruits with delay in cutting, may be due to the transformation of carbohydrates to volatile oils.

Table 4

Percentage of volatile oil components of dill herb and fruits as afected by cutting date

Peak No.	RRT*	Identification time.	Herb								Fruits			
			Date of 1st cut. (Days after sowing)				Date of 2nd Cut. (Days after 1st cut)				From plants growing after The 2nd cut. Days after 1st Cut.			
			45	60	75	90	15	30	45	60	15	30	45	60
1	0.12	α-pinene	2.3	1.6	7.1	6.5	8.1	2.5	16.1	10.5	-	-	18.0	16.9
2	0.19	Camphene	-	-	-	-	-	1.2	1.1	-	23.1	23. 4	18 .8	17.2
3	0.23	Cineol	1.2	-	5.3	4.2	-	6.6	6.2	5.8	-	-	-	-
4	0.24	β-pinene	-	-	-	-	3.0	-	-	-	-	-	-	-
5	0.27	Myrcene	-	-	-	-	-	-	-	1.0	-	-	-	-
6	0.3	Terpinene	5.8	5.9	-	10.4	8.0	7.2	1.1	9.4	-	-	-	
7	0.40	Terpinolene	8.1	12.9	7.0	16.5	4.0	10.4	6.2	6.0	-	-	-	-
8	0.58	M. Heptenone	3.1	-	-	-	-	-	-	-	-	-	-	-
9	0.64	Aldehyde C7	-	-	4.8	9.6	-	-	4.0	8.5	-	-	-	-
10	0.72	Unknown	-	-	-	-	3.5	-	-	-	-	-	-	-
11	0.82	Benzaldehyde	5.0	-	-	-	-	-	-	-	-	-	-	-
12	0.98	Menthone	-	-	8.5	7.8	-	9.3	5.5	-	5.1	4.2	2.1	3.9
13	0.99-1.10	Citronellal	8.4	-	-	-	7.1	-	-	-	9.2	10.0	9.0	8.7
14	1.18	Undecyl aldehyde	-	1.4	-	-	-	-	-	-	-	-	-	-
15	1.28	M. benzoate	-	-	4.2	3.6	-	1.08	1.1	6.6	-	-	-	-
16	1.38	Bornyl acetate	3.9	-	5.0	8.5	4.9	-	-	-	-	-	-	-
17	1.40	Terpineol	-	-	-	-	-	-	-	-	-	11.8	-	-
18	1.42	Citral	-	2.0	-	-	-	3.0	-	-	-	-	10.5	7.9
19	1.51	Piperitone	-	-	-	-	-	-	-	-	6.2	-	-	-
20	1.65	M. salicylate	-	-	-	-	-	2.1	3.8	-	-	-	-	-
21	1.63	Benzyl acetate	-	-	-	-	1.4	-	-	-	-	-	-	-
22	1.70	Citronellol	5.4	-	-	6.4	-	-	-	-	-	-	4.6	7.1
23	1.72	Nerol	-	2.7	-	-	-	3.0	-	-	-	7.2	-	-
24	1.98	O-cresol	-	1.4	-	-	-	2.1	-	-	3.3	-	5.3	8.1
25	2.00	Jasmone	-	-	-	6.4	1.9	-	-	4.6	-	-	-	-
26	2.05	α−Ionone	-	-	13.0	-	-	-	10.4	-	-	8.0	-	-
27	2.12	Manthranilate	-	2.7	-	-	1.9	-	-	-	1.4	-	-	-
28	2.13	Phenyl ethyl alc.	5.7	-	-	-	-	-	-	-	-	-	15.8	11.2
29	2.23	Farnesol	-	7.8	-	-	-	-	-	-	11.8	9.6	7.5	8.6
30	2.47	Eugenol	-	-	11.0	9.4	6.9	-	-	14.6	-	8.4	-	-
31	2.55	Carvacrol	5.3	2.6	-	-	-	-	8.2	-	11.8	6.0	2.3	4.1
32	2.69	Dihydrojasmone	16.0	21.1	16.8	12.3	15.0	24.8	20.2	17.2	8.7	6.6	4.9	5.3
33	3.30	Indol	28.8	-	-	-	27.0	-	-	1.0	0.9	0.3	-	-
34	3.51	Skatol	-	22.1	12.5	-	-	20.1	-	-	-	-	-	-
35	4.05	Unknown	-	13.1	-	-	-	15.4	-	-	-	-	-	-

M = Methyl alc = alcohol.
RRT* = Relative Retention Time.

As regard to the volatile oil concentration in the plants, it was increased gradually up to 75 days from sowing and 45 days from the first cut and then decreased. The reduction in the concentration of volatile oils at 90 days from sowing or at 60 days from the first cut was attributed to the translocation of the oils from the plants to the flowers due to the flowering of the plants as reported before.

The volatile oils in the fruits were increased with increasing the time between cuts up to 45 days after the rust cut and then decreased. This reduction was attributed to the weakness of the plants that developed after 60 days from the first cut.

The GLC analyses of the volatile oils (Table 4) illustrates the great differences between the cutting intervals which are of great value in the choosing of the suitable time for collection of the dill plants. Following observations were made from the data in Table-4.

1. The hydrocarbon components showed the highest percentage in both cuts either the herb or the fruits. The second cut showed higher percentage in hydrocarbon than the first cut in both the herb and fruits. α-Pinene showed higher concentration in the herbs of 45 days after the first cut. In case of fruits the main hydrocarbon was camphane and its highest concentration was observed in fruits collected from plants harvested after 30 days from the first cut.

2. The oxygenated components were observed in most of the investigated sample specially the ketonic components. Regarding the ketonic components, the main and high constituent observed was the dihydrojasmone specially in the first cut in the plants of 60 days old after sowing. The aldehydic components were highly observed also in the fruit samples, specially citronellal was observed in the fruits and achieved higher concentration in the plants of 30 days old after the first cut. The phenolic components were highly observed also in the fruit samples, specially carvacrol which showed highest percentage in the fruits of 15 days old after the first cut. The alcoholic components were observed in the latter stage at the fruit development. The oxides were observed in the herbs in both cuts but were nearly absent in the fruits.

3. The nitrogenous components were observed in the herb specially in the plants of 60 days old after sowing. In case of fruits these components were observed in the earlier stages of the fruits and in minute quantity.

In conclusion, the present study provided an evidence that the date of cutting had a great effect on the yield and on the chemical composition of dill plants and that the proper time for cutting of dill plants was at 75 days from sowing and 45 days after the first cut, for the production of both the herb and the fruit.

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