

## Effect of Gibberillic Acid and Cycocel on *Majorana Hortensis* Mnch<sup>1</sup>

### II. The essential oil

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#### ABSTRACT

Two growth regulators GA and CCC were used in this experiment to study their effect on sweet marjoram plants. The concentrations, used were 25, 50, and 100 ppm for GA and 500, 1,000, 1,500, 2,000 and 4,000 for CCC. The study of the effect of the growth regulators comprised the total fresh weight, the fresh weight of the plant organs, the total dry weight, the dry weight of the plant organs, percentage of essential oil in fresh plant organs, percentage of essential oil in dry plant organs and the physical and chemical properties of fresh leaves and racemes essential oils.

The results of the study showed that the total fresh weight was significantly increased with GA treatments, while it was significantly decreased with CCC treatments. The same result was obtained with the fresh weight of the plant organs except that the racemes were not affected. The total dry weight of the plant as well as that of the plant organs were higher in GA treatments than the control and CCC treatments in all cases. Percentage of essential oil of fresh plant organs was higher in GA 25 ppm and CCC 1500 ppm than the other treatments while in GA 100 ppm it was the lowest. No essential oil was found in the stems. Percentage of essential oil of dry plant organs was almost the same in all treatments. Physical and chemical properties of leaves and raceme oil were almost similar to those reported except the ester number of the raceme oil which was found to be higher than that of the leaf oil.

#### INTRODUCTION

In a previous publication by El-Ghitany *et al.* (4), the effect of GA and CCC on *Majorana hortensis* plants was studied. The study comprised the plant weight, plant diameter, number of branches and the time of blooming.

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As a continuation of our previous study, this part of our work is concerned with the study of the effect of both the two growth regulators GA and CCC on the quantity and quality of the essential oil of sweet marjoram. The aim was to find out a new method of treatment by which to increase the amount of the oil or to improve its quality.

## MATERIALS AND METHODS

The plant material and the chemical used were those used in the previous study on the effect of the two growth regulators on the plant growth (4).

After getting the data for the plant height, the plant diameter, number of branches and the time of blooming of the treated plants, total fresh weight, total dry weight, percentage of the essential oil and its properties were estimated.

## RESULTS AND DISCUSSION

### 1. Effect of GA and CCC on the total fresh weight

Regarding the total fresh weight, highly significant differences were observed between GA and CCC treatments in all cases. The highest increase was due to GA 25 ppm application Table 1. This concentration induced moderate cell elongation and consequently an increase in food assimilation occurred which in turn increased the total fresh weight. The increase in the total fresh weight of plants induced by GA was reported by Wittwer and Bukova (13) and Sciuchetti (11).

Table 1 Effect of GA and CCC on average total fresh weight (in g) of sweet marjoram plants

| Treatments | Average total fresh weight |          |                 |           |
|------------|----------------------------|----------|-----------------|-----------|
|            | 1971 Experiment            |          | 1972 Experiment |           |
|            | 1st cut                    | 2nd cut  | 1st cut         | 2nd cut   |
| GA (ppm)   |                            |          |                 |           |
| 25         | 101.72a                    | 128.06a  | 111.19a         | 126.30a   |
| 50         | 96.14ab                    | 111.81b  | 94.42b          | 114.14ab  |
| 100        | 96.86ab                    | 103.37bc | 94.72b          | 109.47bc  |
| CCC (ppm)  |                            |          |                 |           |
| 500        | 75.94cd                    | 90.36de  | 86.86bc         | 94.95de   |
| 1,000      | 83.81bc                    | 101.50c  | 87.70bc         | 97.81cd   |
| 1,500      | 95.00ab                    | 97.34cd  | 91.42b          | 104.67bcd |
| 2,000      | 80.67c                     | 87.98e   | 76.78cd         | 83.61ef   |
| 4,000      | 64.47d                     | 71.00f   | 68.36d          | 75.25f    |
| Control    | 97.28a                     | 103.34bc | 93.56b          | 105.98bcd |
| L.S.D.     |                            |          |                 |           |
| 0.05       | 13.08                      | 8.59     | 13.53           | 13.97     |
| 0.01       | 17.72                      | 11.68    | 18.40           | 18.94     |

Means with common letter are equal at 0.05 level.

Contrary to the effect of GA it has been found that total fresh weight of the plant was increased with the decrease in CCC concentrations. CCC in low concentration increased chlorophyll formation in leaves and stem diameter and therefore gives rise to increased total fresh weight. High CCC concentrations induced dwarfism in plants resulting in smaller plants with reduced total fresh weight. The effect of CCC was studied by Anderson (1).

## 2. Effect of GA and CCC on the fresh weight of the plant organs

Significant differences between GA and CCC treatments in all cases were observed concerning the fresh weights of the plant organs. GA 25 ppm treatment showed the highest weights of leaves as shown in Tables 2 and 3. The increase in the leaf fresh weight when using GA 25 ppm was mentioned by Wittwer and Bukova (13) and Scott (12).

Treatment with CCC gave average leaf fresh weight more or less around the average of the control treatment except in the case of CCC 4,000 ppm treatment which gave remarkable decrease in the leaf fresh weight. The decrease was due to loss of easily dropped leaves and dwarfism of plants as described by Wittwer and Tolbert (14) and Humphries (8). The increase in the fresh weight of the racemes was also observed which was also highest with GA 25 ppm concentration.

Treatment with CCC 4,000 gave the lowest fresh weight. The effect of plant growth regulators on the flowers was previously studied by Marth *et al.* (10) and Kuraiski and Muir (9).

As shown before, GA 100 ppm concentration induced moderate cell elongation, this could be due to the fact that this concentration gave the highest fresh weight in

Table 2 Effect of GA and CCC on average fresh weight of the plant organs (in g) of sweet marjoram in 1971

| Treatments | Average fresh weight of plant parts in 1971 experiment |         |         |         |         |          |
|------------|--------------------------------------------------------|---------|---------|---------|---------|----------|
|            | 1st cut                                                |         |         | 2nd cut |         |          |
|            | Leaves                                                 | Racemes | Stem    | Leaves  | Racemes | Stems    |
| GA (ppm)   |                                                        |         |         |         |         |          |
| 25         | 56.72a                                                 | 42.16ab | 16.09bc | 73.25a  | 28.56a  | 20.22bc  |
| 50         | 51.81ab                                                | 38.50b  | 19.03b  | 58.90b  | 28.50a  | 21.03b   |
| 100        | 33.72ab                                                | 31.42c  | 28.70c  | 25.17bc | 25.20a  | 28.45a   |
| CCC (ppm)  |                                                        |         |         |         |         |          |
| 500        | 20.75c                                                 | 37.61b  | 11.64cd | 47.22bc | 22.45a  | 15.00d   |
| 1,000      | 26.33c                                                 | 38.39b  | 11.28cd | 52.95b  | 23.33a  | 17.73bcd |
| 1,500      | 26.50c                                                 | 40.72ab | 14.12c  | 46.56bc | 28.75a  | 16.44bcd |
| 2,000      | 21.86c                                                 | 38.50b  | 9.86d   | 55.64b  | 22.39a  | 14.94d   |
| 4,000      | 20.64c                                                 | 32.06c  | 9.61d   | 33.50c  | 19.97a  | 14.40d   |
| Control    | 31.14bc                                                | 45.03a  | 14.03c  | 55.61b  | 26.78a  | 16.00cd  |
| L.S.D.     |                                                        |         |         |         |         |          |
| 0.05       | 24.85                                                  | 5.49    | 3.54    | 15.31   | 8.30    | 4.68     |
| 0.01       | 33.68                                                  | 7.44    | 4.82    | 20.75   | 11.24   | 6.36     |

Means with common letter are equal at 0.05 level.

Table 3 Effect of GA and CCC on average fresh weight of plant organs (in g) of sweet marjoram plants in 1972

| Treatments | Average fresh weight of plant parts in 1972 exp. |         |          |         |         |          |
|------------|--------------------------------------------------|---------|----------|---------|---------|----------|
|            | 1st cut                                          |         |          | 2nd cut |         |          |
|            | Leaves                                           | Racemes | Stems    | Leaves  | Racemes | Stems    |
| GA (ppm)   |                                                  |         |          |         |         |          |
| 25         | 42.22a                                           | 42.89ab | 19.47cde | 67.92a  | 33.50a  | 21.14bcd |
| 50         | 33.75b                                           | 37.61b  | 23.33b   | 54.31b  | 34.33a  | 21.81bc  |
| 100        | 22.89cd                                          | 33.64c  | 33.91a   | 39.50a  | 39.50cd | 30.28a   |
| CCC (ppm)  |                                                  |         |          |         |         |          |
| 500        | 24.00c                                           | 39.78bc | 18.08cde | 43.64cd | 29.48a  | 19.20bcd |
| 1,000      | 20.67cd                                          | 41.70ab | 18.50ab  | 42.59cd | 30.33a  | 19.36bcd |
| 1,500      | 43.00a                                           | 46.64a  | 20.19bcd | 30.61bc | 30.45a  | 18.78cd  |
| 2,000      | 23.28c                                           | 38.00bc | 17.42de  | 36.11de | 27.06a  | 17.92cd  |
| 4,000      | 20.36c                                           | 35.00c  | 16.42e   | 25.75e  | 26.61a  | 16.50d   |
| Control    | 27.58bc                                          | 42.81ab | 21.17bc  | 46.70bc | 32.67a  | 23.78b   |
| L.S.D.     |                                                  |         |          |         |         |          |
| 0.05       | 8.03                                             | 6.69    | 3.56     | 10.40   | 7.14    | 4.99     |
| 0.01       | 10.88                                            | 9.06    | 4.84     | 14.10   | 9.68    | 6.78     |

Means with common letter are equal at 0.05 level.

stems than other treatment. It would be also explained that CCC 4,000 ppm concentration gave the lowest average in stems due to induced dwarfism as mentioned by Humphries (8) and Halevy and Wittwer (7).

### 3. Effect of GA and CCC on the total dry weight of the plant

Analysis of variance for dry weight showed highly significant differences among the treatments of both the two cuts of the two years. The total dry weight increases with the increase in GA concentration. (Table 4). The correlation existing between the total fresh weight and the different treatments is almost similar to that between the total dry weight and the different treatments. The obtained results coincide with those reported by Brian *et al.* (2) and Cabler (3).

### 4. Effect of GA and CCC on the dry weight of the plant organs (leaves, racemes and stems)

Concerning the dry weight of the plant organs, GA 25 ppm treatment showed an increase in the average dry weight of the leaves but a decrease in the average dry weight of the stems (Table 5 and 6), while GA 100 ppm treatment showed opposite results i.e. decrease in the average dry weight of the leaves and an increase in that of the stem. This result was reported by Cabler (3).

### 5. Effect of GA and CCC on the percentage of essential oil in the fresh plant organs (leaves, racemes and stems)

In comparison with the control plants, an increase in the percentage of the essential oil both in the leaves and racemes in this work was reported (Table 7). As far as we

Table 4 Effect of GA and CCC on average total dry weight (in g) sweet marjoram plants

| Treatments | Average total dry weight |         |                 |
|------------|--------------------------|---------|-----------------|
|            | 1971 Experiment          |         | 1972 Experiment |
|            | 1st cut and 2nd cut      | 1st cut | 2nd cut         |
| GA (ppm)   |                          |         |                 |
| 25         | 38.44a                   | 47.33ab | 41.00a          |
| 50         | 37.06a                   | 49.11ab | 35.67ab         |
| 100        | 37.44a                   | 44.33bc | 40.00d          |
| CCC (ppm)  |                          |         |                 |
| 500        | 23.44cd                  | 44.00bc | 22.89c          |
| 1,000      | 20.11d                   | 51.33a  | 18.44c          |
| 1,500      | 24.11bc                  | 39.67cd | 22.00c          |
| 2,000      | 24.00bc                  | 37.00de | 20.33c          |
| 4,000      | 21.56cd                  | 30.89e  | 18.22c          |
| Control    | 26.89b                   | 37.33d  | 29.89b          |
| L.S.D.     |                          |         |                 |
| 0.05       | 3.25                     |         | 6.15            |
| 0.01       | 4.28                     |         | 8.10            |

know this is the first time to report an increase in sweet marjoram oil to be achieved in plants treated with GA.

According to Sciuchetti (11), GA has no effect on the essential oil percentage of sweet marjoram plant. However, this experiment showed that low concentrations of GA (25 ppm) induce light increase in the oil content comparing with the control plants

Table 5 Effect of GA and CCC on average dry weight of the plant organs (in g) of sweet marjoram plants in 1971

| Treatments | Average dry weight of the plant organs of 1971 exp. |         |        |         |         |        |
|------------|-----------------------------------------------------|---------|--------|---------|---------|--------|
|            | 1st cut                                             |         |        | 2nd cut |         |        |
|            | Leaves                                              | Racemes | Stems  | Leaves  | Racemes | Stems  |
| GA (ppm)   |                                                     |         |        |         |         |        |
| 25         | 16.67a                                              | 17.56a  | 7.44bc | 16.67a  | 12.22b  | 7.44bc |
| 50         | 14.11a                                              | 18.00a  | 8.61b  | 14.11a  | 10.78bc | 8.61b  |
| 100        | 10.06b                                              | 13.67b  | 13.22a | 10.06b  | 16.22a  | 13.22a |
| CCC (ppm)  |                                                     |         |        |         |         |        |
| 500        | 7.61bc                                              | 13.00b  | 5.50de | 7.61bc  | 7.67cd  | 5.50de |
| 1,000      | 7.56bc                                              | 11.67bc | 3.72f  | 7.56bc  | 6.00d   | 3.72f  |
| 1,500      | 7.50bc                                              | 13.56b  | 4.28ef | 7.50bc  | 11.00bc | 4.28ef |
| 2,000      | 8.06bc                                              | 11.56bc | 4.61ef | 8.06bc  | 11.00bc | 4.61ef |
| 4,000      | 6.72c                                               | 9.44c   | 6.44cd | 6.72c   | 7.22d   | 6.44cd |
| Control    | 10.17b                                              | 14.67ab | 5.55de | 10.17b  | 7.33d   | 5.55de |
| L.S.D.     |                                                     |         |        |         |         |        |
| 0.05       | 2.69                                                | 3.38    | 1.50   | 2.69    | 3.38    | 1.50   |
| 0.01       | 3.43                                                | 4.46    | 1.99   | 3.43    | 4.46    | 1.99   |

Means with common letter are equal at 0.05 level.

Table 6 Effect of GA and CCC on average dry weight of the plant organs (in g) of sweet marjoram plants in 1972.

| Treatments | Average dry weight of the plant organs of 1972 exp. |         |        |         |           |        |
|------------|-----------------------------------------------------|---------|--------|---------|-----------|--------|
|            | 1st cut                                             |         |        | 2nd cut |           |        |
|            | Leaves                                              | Racemes | Stems  | Leaves  | Racemes   | Stems  |
| GA (ppm)   |                                                     |         |        |         |           |        |
| 25         | 13.44a                                              | 21.44bc | 10.61b | 19.00a  | 13.22ab   | 10.61b |
| 50         | 10.56bc                                             | 15.00d  | 9.22bc | 16.00b  | 10.67bcd  | 9.22bc |
| 100        | 7.11de                                              | 16.33d  | 17.83a | 11.22c  | 14.56a    | 17.83a |
| CCC (ppm)  |                                                     |         |        |         |           |        |
| 500        | 8.89bcd                                             | 23.78ab | 8.72bc | 9.11d   | 8.00cde   | 8.72bc |
| 1,000      | 10.67b                                              | 25.89a  | 9.00bc | 7.67de  | 6.44e     | 9.00bc |
| 1,500      | 6.78e                                               | 22.78ab | 7.89c  | 6.11e   | 10.22bcde | 7.89c  |
| 2,000      | 6.89de                                              | 16.33d  | 8.89d  | 7.22de  | 11.00abc  | 8.89bc |
| 4,000      | 4.44f                                               | 17.67cd | 6.78c  | 6.78c   | 7.11de    | 6.78c  |
| Control    | 8.56de                                              | 17.22d  | 8.94bc | 15.00b  | 8.56cde   | 8.94bc |
| L.S.D.     |                                                     |         |        |         |           |        |
| 0.05       | 2.02                                                | 3.80    | 2.74   | 2.02    | 3.80      | 2.74   |
| 0.01       | 3.92                                                | 5.01    | 3.61   | 3.92    | 5.01      | 3.61   |

Means with common letter are equal at 0.05 level.

which did not appear statistically. This increase is due to moderate growth of the plant associated with an increase in essential oil assimilation. In case of using high concentrations of GA (100 ppm) oil assimilation became slow.

Treatments with CCC apparently increased the oil percentages in the plant. The increase was not directly due to CCC effect but it was due to the formation of chlorophyll which helps in food assimilation and indirectly increase the percentage of the oil.

The percentage of the oil in general differs from one organ to another but it was found to be higher in the flowers than in the other organs of the plant (Table 7). The stems are almost free from the oil.

#### 6. Effect of GA and CCC on the percentage of essential oil in the dry plant organs (Leaves, racemes, and stems)

The results obtained from analysis for the essential oil percentage of the dry plant organs (Table 8) showed the following:

No essential oil was found in the dry stems.

GA 25 and CCC 500 ppm treatments gave the highest oil percentage while GA 100 ppm gave the lowest percentage in the leaves.

GA 25, CCC 500, 1,000 and 4,000 ppm applications gave the same results given in the control treatment.

GA 100 ppm treatment gave the lowest essential oil percentage.

#### 7. Effect of GA and CCC on oil properties

Regarding the physical and chemical properties of the essential oil of sweet marjoram, treated plants with both GA and CCC, the obtained results were found to be fluctuating (Table 9), but within the range of those reported for untreated sweet

Table 7 Effect of GA and CCC on average percentage of essential oil of the fresh plant organs (in % weight)

| Treatments | Average percentage of essential oil |         |         |          |                 |         |         |         |
|------------|-------------------------------------|---------|---------|----------|-----------------|---------|---------|---------|
|            | 1971 Experiment                     |         |         |          | 1972 Experiment |         |         |         |
|            | 1st cut                             |         | 2nd cut |          | 1st cut         |         | 2nd cut |         |
|            | Leaves                              | Racemes | Leaves  | Racemes  | Leaves          | Racemes | Leaves  | Racemes |
| GA (ppm)   |                                     |         |         |          |                 |         |         |         |
| 25         | 0.68ab                              | 0.83bc  | 0.67b   | 0.77abc  | 0.72a           | 0.84bc  | 0.67a   | 0.78a   |
| 50         | 0.64c                               | 0.76c   | 0.63cd  | 0.65d    | 0.63e           | 0.80e   | 0.58cde | 0.67c   |
| 100        | 0.55de                              | 0.68c   | 0.42g   | 0.52e    | 0.57f           | 0.70d   | 0.35f   | 0.50d   |
| CCC (ppm)  |                                     |         |         |          |                 |         |         |         |
| 500        | 0.65bc                              | 0.92ab  | 0.66bc  | 0.82a    | 0.69bc          | 1.02a   | 0.62abc | 0.76a   |
| 1,000      | 0.64c                               | 0.79bc  | 0.48f   | 0.66cd   | 0.67cd          | 0.78d   | 0.53de  | 0.69bc  |
| 1,500      | 0.69a                               | 1.04a   | 0.61d   | 0.80ab   | 0.66d           | 0.82bc  | 0.66ab  | 0.73ab  |
| 2,000      | 0.54e                               | 0.83bc  | 0.55e   | 0.69bcd  | 0.56g           | 0.79cd  | 0.59bcd | 0.74ab  |
| 4,000      | 0.58d                               | 1.00a   | 0.75a   | 0.69bcd  | 0.63e           | 0.85bc  | 0.65abc | 0.69bc  |
| Control    | 0.67abc                             | 0.82bc  | 0.55e   | 0.75abcd | 0.70ab          | 0.89b   | 0.51e   | 0.75a   |
| L.S.D.     |                                     |         |         |          |                 |         |         |         |
| 0.05       | 0.041                               | 0.164   | 0.041   | 0.123    | 0.062           | 0.103   | 0.080   | 0.061   |
| 0.01       | 0.056                               | 0.221   | 0.056   | 0.160    | 0.080           | 0.130   | 0.110   | 0.083   |

Means with common letter are equal at 0.05 level.

N.B. No essential oil was found in the fresh stems.

Table 8 Effect of GA and CCC on average percentage of essential oil of the dry plant organs (in % weight)

| Treatments | Average percentage of essential oil |         |
|------------|-------------------------------------|---------|
|            | 1971 and 1972 Experiments           |         |
|            | First and second cuts               |         |
|            | Leaves                              | Racemes |
| GA (ppm)   |                                     |         |
| 25         | 1.93a                               | 2.09a   |
| 50         | 1.77ab                              | 1.83b   |
| 100        | 1.33c                               | 1.53c   |
| CCC (ppm)  |                                     |         |
| 500        | 1.95a                               | 2.14a   |
| 1,000      | 1.83ab                              | 2.05a   |
| 1,500      | 1.79ab                              | 1.82b   |
| 2,000      | 1.72ab                              | 1.80b   |
| 4,000      | 1.62b                               | 2.12a   |
| Control    | 1.86ab                              | 2.23a   |
| L.S.D.     |                                     |         |
| 0.05       | 0.29                                | 0.21    |
| 0.01       | 0.39                                | 0.28    |

Means with common letter are equal at 0.05 level.

*N.B.* No essential oil was found in the dry stems.

marjoram plants as reported by Guenther 1960 (6) and Gildemeister and Hoffmann (5).

The only difference observed was that of the ester value which was higher in case of oil in the leaves.

Table 9 Effect of GA and CCC on average physical and chemical properties of sweet marjoram fresh leaf oil

|            | Average physical & chemical properties |                  |                  |              |                           |
|------------|----------------------------------------|------------------|------------------|--------------|---------------------------|
| Treatments | Specific gravity                       | Refractive index | Optical rotation | Ester value  | Colour                    |
| GA (ppm)   |                                        |                  |                  |              | Yellow to yellowish-green |
| 25         | 0.8893                                 | 1.475            | +16° 0           | 53.96        |                           |
| 50         | 0.8764                                 | <u>1.474</u>     | +15° 50          | <u>41.46</u> |                           |
| 100        | 0.8860                                 | 1.479            | +15° 25          | <u>48.00</u> |                           |
| CCC (ppm)  |                                        |                  |                  |              |                           |
| 500        | 0.8891                                 | 1.480            | <u>+15° 0</u>    | 51.12        |                           |
| 1,000      | <u>0.8915</u>                          | <u>1.482</u>     | +18° 0           | 51.79        |                           |
| 1,500      | 0.8897                                 | 1.476            | +15° 50          | 49.17        |                           |
| 2,000      | 0.8913                                 | 1.477            | +15° 75          | 49.76        |                           |
| 4,000      | 0.8900                                 | 1.477            | +18° 25          | 42.32        |                           |
| Control    | 0.8900                                 | 1.480            | +18° 50          | 54.62        |                           |

*N.B.* No variations were found in the fresh leaves essential oil properties between 1971 and 1972 experiments.

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تأثير حمض الجبريليك والسيكوسيل على نبات البردقوش

٢ - الزيت الطيار

محمد يسري الغيطاني - فوزي طه حسين - عبد المجيد سليم

### المستخلص

في بحث سابق تم دراسة تأثير كل من حمض الجبريليك والسيكوسيل على نمو نبات البردقوش . وتماما لما سبق دراسته اجري هذا البحث لدراسة تأثير كل من المنظمين المذكورين على نبات البردقوش متناولين النقاط الآتية :-

- ١ - الوزن الكلي الطازج للنبات .
- ٢ - الوزن الطازج لاجزاء النبات المختلفة ( الازهار - الاوراق - السيقان )
- ٣ - الوزن الكلي الجاف للنبات .
- ٤ - الوزن الجاف لاجزاء النبات المختلفة ( الازهار - الاوراق - السيقان )
- ٥ - نسبة الزيت الطيار باجزاء النبات الطازجة ( الازهار - الاوراق - السيقان ) .
- ٦ - نسبة الزيت الطيار باجزاء النبات الجافة ( الازهار - الاوراق - السيقان ) .
- ٧ - المواصفات الطبيعية والكيميائية لزيت البردقوش (زيت الاوراق وزيت الازهار) .

وقد اثبتت التجارب ان حمض الجبريليك يؤثر بالزيادة وان السيكوسيل مؤثر بالنقص على كل من الوزن الكلي الطازج للنبات والوزن الطازج لاجزاء مختلفة والوزن الكلي الجاف للنبات والوزن الجاف لاجزاء مختلفة وان حمض الجبريليك بتركيز ٢٥ جزء في المليون والسيكوسيل بتركيز ١٥٠٠ جزء في المليون يؤثر كل منهما بالزيادة في نسبة الزيت الطيار في اجزاء النبات الطازجة . ولم يظهر أى تأثير لتركيزات المنظمين المختلفة على المواصفات الطبيعية والكيميائية لزيت البردقوش .