Response of Sweet Basil (Ocimum Basilicum L.) to Spray of Aspartic and Glutamic Acids, and Their Effect on Its Growth and Its Volatile Oil Content

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Abstract

Experiment was conducted in fields of Agriculture College, Al-Muthanna University, during the growing season 2020, to study the response of sweet basil (Ocimum basilicum L.) to spraying three concentrations of aspartic acid (0, 75 and 150 mg.L⁻¹) and with three concentrations of glutamic acid (0, 75 and 150 mg.L⁻¹), and their impact on its growth and essential oil content. Results showed that the basil plants that have been sprayed with aspartic acid at a concentration (150 mg.L⁻¹) significantly superior in plant height, fresh and dry weight of shoot, percentage and yield of volatile oil (45.61cm, 19.70 gm.plant⁻¹, 1.80 gm.plant⁻¹, 1.75 % and 31.48 µL.plant⁻¹ ) respectively. Results also showed the significant effect of spraying glutamic acid at a concentration (150 mg.L⁻¹), which gave highest values in plant height, fresh and dry weight of shoot, percentage and yield of volatile oil (48.67 cm, 20.28 gm.plant⁻¹, 1.83 gm.plant⁻¹, 1.56 % and 29.08 µL.plant⁻¹) respectively.

Keywords: Ocimum basilicum L., Sweet basil, Aspartic acid, Glutamic acid, Essential oil

1. Introduction

Ocimum basilicum L. (commonly known as basil or sweet basil) is a well-known and appreciated spice and medicinal plant. Is an annual herb belonging to the Labiatae family distributed in many regions around the world. Sweet basil is an important aromatic plant that is an important source of flavoring materials that are used in food and perfume industry, and in treatment of diseases. It is one of the most important food and medicinal plants that are grown in Iraq and are extensively used in fresh food and in the food processing industry. Traditionally, for its medicinal properties sweet basil used in the treatment of, headaches, worms, constipation, coughs, diarrhea, and congestion kidney [1]. In addition, various pharmacological activity have been described of basil plant such as, stomachic, stimulant antispasmodic, and galactagogue, also, tea of basil used to treatment nausea, flatulence, and dysentery [2,3]. Basil volatile oil have a number of biological activities such as antifungal, antibacterial, insecticidal and anti-malarial [4]. Volatile oil that is extracted from leaves is used in the food, pharmaceutical and cosmetics industries [5]. Basil Volatile oil contains a number of main constituents such as linalool, methyl chavicol, eugenol, 1,8-cineole, neral, geranial, methyl cinnamate [6,7]. Basil volatile oil also contains flavonoids and caffeic acid derivatives[8].

Amino acids are considered as precursors and components of proteins [9], which are imperative to stimulation of cell growth. Numerous hypotheses have been proposed to expound the role of amino acids in plant growth. Available evidence indicate several alternative pathway of indol acetic acid (IAA) synthesis in plants, it all start with amino acids [10]. In addition to being a constituent of proteins, aspartic acid serves as a central building block for many metabolic processes in most organisms, like biosynthesis of other amino acids, nicotinamide adenine dinucleotide (NAD), tricarboxylic acid (TCA), nucleotides, cycle and glycolysis pathway intermediates, and hormones, which are pivotal for growth and defense [11]. Glutamic acid play a vital role in synthesis of vegetative tissue and chlorophyll. Is also have a chelating effect on micronutrients through making their absorption and transportation easier for the plant, which are precursors of phytohormones and growth substances[12]. For importance of sweet basil plant and for improving its cultivation in Iraq conducted this study, which aims to explore the extant of response to spraying with aspartic and glutamic acids and their effect on its growth and content of volatile oil.

2. Materials and Methods

Experiment was carried out at fields of Agricultural Research Station (2), College of Agriculture / Al-Muthanna University in south of Iraq, from 1/March to10/June, 2020, to study the effect of aspartic acid spray with three concentrations (0, 75, 150...
mg.L\(^{-1}\)) and glutamic acid spray with three concentrations (0, 75, 150 mg.L\(^{-1}\)) on growth and volatile oil yield of sweet basil plant. Treatments were arranged in a factorial experiment according to a Randomized Complete Block Design with three replications. Chemical and physical properties of soil were estimated before planting (Table 1). The field was divided into three replications, each of which included 9 experimental units, dimensions of each (2m × 2m). Seeds were planted in experimental unit in lines (35 cm between a line and another, and 20 cm between plant and other). A uniform amount of nitrogen and phosphate fertilizations ((120 Kg N.ha\(^{-1}\) and 100 Kg P\(_2\)O\(_5\).ha\(^{-1}\)), respectively, were added to all experimental units. Aspartic and glutamic acid solutions were sprayed in two batches for each., and for 7 days between batch and another, alternating between the two acids, started 30 days after the plants emergence from the soil surface. Parameters recorded were plant height, shoot fresh weight, shoot dry weight, volatile oil percentage and yield of volatile oil. Percentage of volatile oil was determined by hydro distillation method according to the method described by [13] with modifications. After drying the vegetative aggregates of plants by air, in shaded places, 25 g of plant powder were taken per treatment and placed in a 1 liter flask in a Clevenger apparatus, 500 ml of water was added to it, hydro distillation process was carried out for 3 hours. The volatile oil ratio was measured by using dry yield (biomass yield) of basil. All statistics analysis was performed by analysis of variance (ANOVA) and least significant difference (LSD) at probability of 0.05.

### Table 1. The soil properties.

| Measurements | Value | Unit of measurement |
|--------------|-------|---------------------|
| N            | 12    | mg.kg\(^{-1}\)      |
| P            | 16    | mg.kg\(^{-1}\)      |
| K            | 190   | mg.kg\(^{-1}\)      |
| O.M          | 1.3   | %                   |
| pH           | 7.2   |                     |
| EC           | 5.4   | ds.m\(^{-1}\)       |
| Clay         | 63    | %                   |
| Silt         | 21    | %                   |
| Sand         | 16    | %                   |
| Texture      |       | Sandy loam          |

### 3. Results and Discussion

#### 3.1 Plant height

Results of Table (2) showed that the significantly effect of spraying aspartic acid concentrations on height of sweet basil plant, where the spray exceeded the concentration 150 mg.L\(^{-1}\) and gave highest value of plant height (45.61 cm), a comparison with a control treatment that gave lowest values (39.65 cm). Results also showed the significant effect of glutamic acid concentrations on plant height characteristic, the concentration 150 mg.L\(^{-1}\) gave highest height reached 48.67 cm. a comparison with a control treatment that gave lowest values (36.64 cm.). Interaction between the two experiment factors had a significant effect on plant height, highest values of plant height were recorded from interaction between aspartic acid spray (150 mg. L\(^{-1}\)) with glutamic acid spray (150 mg. L\(^{-1}\)) reached 49.54 cm.

### Table 2. Response of sweet basil to spray aspartic and glutamic acids, and their impact in plant height (cm.)

| Aspartic acid (mg.L\(^{-1}\)) | Glutamic acid (mg.L\(^{-1}\)) | Mean |
|-----------------------------|-------------------------------|------|
|                            | 0    | 75  | 150 |      |
| 0                           | 29.63 | 41.79 | 47.20 | 39.65 |
| 75                          | 38.88 | 47.64 | 48.94 | 45.15 |
| 150                         | 41.43 | 45.87 | 49.54 | 45.61 |
| Mean                       | 36.64 | 45.10 | 48.67 |      |
| L.S.D\(_{0.05}\)            | 2.57  | 2.57  | 4.45  |      |

#### 3.2 Shoot fresh weight

Data presented in Table (3) showed that the significantly effect of spraying aspartic acid concentrations on shoot fresh weight of sweet basil plant, where spray exceeded the concentration 150 mg.L\(^{-1}\) and gave highest value of shoot fresh weight reached 19.70 gm.plant\(^{-1}\) a comparison with a control treatment that gave lowest value (15.62). Results also showed the significant effect of glutamic acid concentrations on shoot fresh weight, the concentration (150 mg.L\(^{-1}\) ) gave highest value reached 20.28 a comparison with a control treatment that gave lowest value (15.01 gm.plant\(^{-1}\)). Interaction between the two
experiment factors had a significant effect on shoot fresh weight, highest value for this characteristic were recorded from the interaction between aspartic acid spray (150 mg.L⁻¹) with glutamic acid spray (150 mg.L⁻¹) reached 21.81 gm. plant⁻¹.

**Table 3.** Response of sweet basil to spray aspartic and glutamic acids, and their impact in shoot fresh weight (gm. plant⁻¹)

| Aspartic acid (mg.L⁻¹) | Glutamic acid (mg.L⁻¹) | Mean       |
|------------------------|------------------------|------------|
| 0                      | 12.50                  | 15.62      |
| 75                     | 15.54                  | 18.74      |
| 150                    | 17.00                  | 20.29      |
| Mean                   | 15.01                  | 18.10      |
| L.S.D₀.₀₅              | Aspartic acid          | 1.6        |
|                        | Glutamic acid          | 1.6        |
|                        | Aspartic acid × Glutamic acid | 2.77       |

3.3 Shoot dry weight

Results of Table 4 showed that the significantly effect of spraying aspartic acid concentrations on shoot dry weight of sweet basil plant, where spray exceeded the concentration 150 mg.L⁻¹ and gave highest value for this characteristic reached 1.80 gm. plant⁻¹ a comparison with a control treatment that gave lowest value reached 1.41 gm. plant⁻¹. Results also showed the significant effect of glutamic acid concentrations on shoot dry weight characteristic, the concentration 150 mg.L⁻¹ gave highest weight reached 1.83 gm. plant⁻¹ a comparison with a control treatment that gave lowest value reached 1.38 gm. plant⁻¹. Interaction between the two experiment factors had a significant effect on shoot dry weight, the highest value of this characteristic were recorded from the interaction between aspartic acid spray (150 mg. L⁻¹) with glutamic acid spray (150 mg. L⁻¹) reached 2.0 gm. plant⁻¹.

**Table 4.** Response of sweet basil to spray aspartic and glutamic acids, and their impact in shoot dry weight (gm. plant⁻¹).  

| Aspartic acid (mg.L⁻¹) | Glutamic acid (mg.L⁻¹) | Mean |
|------------------------|------------------------|------|
| 0                      | 1.15                   | 1.65 |
| 75                     | 1.45                   | 1.85 |
| 150                    | 1.55                   | 2.00 |
| Mean                   | 1.38                   | 1.83 |
| L.S.D₀.₀₅              | Aspartic acid          | 0.16 |
|                        | Glutamic acid          | 0.16 |
|                        | Aspartic acid × Glutamic acid | 0.27       |

3.4 Volatile oil percentage

Data presented in Table 5 showed that the significantly effect of spraying aspartic acid concentrations on volatile oil percentage, where the spray exceeded the concentration 150 mg.L⁻¹ and gave highest value for this characteristic reached 1.75 % a comparison with a control treatment that gave lowest value (1.16%). Results also showed the significant effect of glutamic acid concentrations on volatile oil percentage, concentration (150 mg.L⁻¹) gave highest value reached 1.56 % a comparison with a control treatment that gave lowest value (1.41%). Interaction between the two experiment factors had a significant effect on volatile oil percentage, highest value for this characteristic were recorded from the interaction between aspartic acid spray (150 mg. L⁻¹) with don’t spray glutamic acid (water spray only) reached 1.80%.

**Table 5.** Response of sweet basil to spray aspartic and glutamic acids, and their impact in volatile oil content (%)

| Aspartic acid (mg.L⁻¹) | Glutamic acid (mg.L⁻¹) | Mean |
|------------------------|------------------------|------|
| 0                      | 1.00                   | 1.30 |
| 75                     | 1.60                   | 1.70 |
| 150                    | 1.80                   | 1.70 |
| Mean                   | 1.46                   | 1.56 |
| L.S.D₀.₀₅              | Aspartic acid          | 0.09 |
|                        | Glutamic acid          | 0.09 |
|                        | Aspartic acid × Glutamic acid | 0.17       |
3.5 Yield of volatile oil

Results of Table (6) showed that the significantly effect of spraying aspartic acid concentrations on the volatile oil yield of basil plant, where the spray exceeded the concentration 150 mg.L\(^{-1}\) and gave highest value for this characteristic reached 31.48 µL.plant\(^{-1}\) a comparison with a control treatment that gave lowest value (16.79 µL.plant\(^{-1}\)). Results also showed the significant effect of glutamic acid concentrations on volatile oil yield characteristic, concentration 150 mg.L\(^{-1}\) gave highest value reached 29.08 µL.plant\(^{-1}\) a comparison with a control treatment that gave lowest value (20.83 µL.plant\(^{-1}\)). Interaction between the two experiment factors had a significant effect on this characteristic, highest value of volatile oil yield were recorded from the interaction between aspartic acid spray (150 mg. L\(^{-1}\)) with glutamic acid spray (150 mg. L\(^{-1}\)) reached 34.0 µL.plant\(^{-1}\).

Table 6. Response of sweet basil to spray aspartic and glutamic acids, and their impact in yield of volatile oil (µL.plant\(^{-1}\)).

| Aspartic acid (mg.L\(^{-1}\)) | Glutamic acid (mg.L\(^{-1}\)) | Mean  |
|------------------------------|------------------------------|-------|
| 0                           | 17.42                        | 21.45 | 16.79 |
| 75                          | 27.88                        | 31.78 | 27.58 |
| 150                         | 34.00                        | 31.48 |
| Mean                        | 25.95                        | 29.08 |
| L.S.D\(_{0.05}\)            | 1.15                         | 2.00  |

The significant superiority to aspartic and glutamic acids spray in growth and content of volatile oil may be due to the amino acids are an important for growth regulation and as modulators of growth and cell differentiation, which may be affecting general metabolism and accordingly morphogenesis [14], or, they are crucial to activate cell growth, act as buffers, provide a source of carbon and energy and keep the cells from ammonia toxicity [15], or, the amino acids are involved in the synthesis of organic compounds, like proteins, amines, enzymes, alkaloids, terpenoids, plant hormones and vitamins that control various plant processes [16, 17].

Conclusion

In this study (according of environmental conditions of southern Iraq, Province of Al-Muthanna-Samawa city) it was found that aspartic and glutamic acids spray in concentration (150 mg. L\(^{-1}\) and 150 mg L) respectively, were the most appropriate and best for growth vegetative of sweet basil plant, which reflected positively on its content of volatile oil.

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