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# EFFECT OF NPK, HUMIC ACID AND DRY YEAST ON GROWTH, OIL YIELD AND CHEMICAL CONSTITUENTS OF SWEET BASIL (*Ocimum basilicum* L.)

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**ABSTRACT:**

*The present work was carried out during 2019 and 2020 seasons at the Experimental Lathe-house, Fac. Tech.& Develop., Zagazig Univ., to evaluate to what extent can use Humic acid and/ or active dry yeast applications instead of/ or compensate the NPK chemical fertilization for enhancing vegetative growth, herb yield and essential oil yield.*

***The obtained results can be summarized as follows:*** *The treatments of 2.5 g NPK/ pot, 2.5 g/ L Humic acid + 8.0 g/ L dry yeast extract, and the interaction of the treatment of 2.5 g NPK/ pot, with 2.5 g/ L Humic acid + 8.0 g/ L dry yeast extract, being the most effective on vegetative growth, oil yield and the chemical constituents of volatile oils of sweet basil plants, followed by the treatments of 2.5 g NPK/ pot , with 12 g/ L dry yeast extract , and 2.5 g NPK/ pot , with 5 g/ L Humic acid , respectively, in most cases , in the two times of cutting of this study.*

***Conclusively, f****rom this study and the obtained results, it can be concluded that the medium level of NPK at 2.5 g / pot, 2.5 g/l Humic acid + 8.0 g/l dry yeast, and its interaction were recorded the highest values on plant growth characters, chemical contents, pigments, oil yield, and chemical constituents of volatile oils. As well as, the suitable rate of humic acid and dry yeast extract can compensate the high level of NPK doses.*

**Key words**: sweet basil, NPK fertilization, Humic acid, dry yeast extract, chemical constitute of oil yield.

## INTRODUCTION

Medicinal and aromatic plants contain substances that can be used for therapeutic purposes. It is known in the modern and ancient civilization for their healing properties.

Sweet basil (*Ocimum basilicum* L.) comprises several aromatic and medicinal *Lamiaceae* herbs belong to different species (Koba *et al*., 2009). The useful parts of the basil plants are their leaves and seeds. Where each of the fresh and dry leaves is commonly used in food and spice industries.

Furthermore, it is also considered as a source of aroma compounds and thus, possesses a range of biological properties and antioxidant properties (Lee *et al*., 2005).

Recently, some efforts are paid to minimize the amounts of chemical fertilizers (N, P and K) in which applied to medicinal and aromatic plants in order to reduce each of production cost and environmental pollution without reduction of yield and oil yield (Mohamed *et al*., 2017).

Humic acid, and dry yeast extracts are used to compensate the amount of chemical fertilizers application, where Humic acid has a higher carbon percentage and several benefits as an integral part of their fertilizer program.

Humic acid is one of the major components of humus, El. Sayed *et al*.,(2015), illustrated that the application of 125 ppm with Humic acid increased all growth parameters of basil plant (plant height, number of branches, leaf area, herb fresh and dry weights) and oil percentages in herb compared to the other treatments. Moreover, Bayat and Belopukhov (2019) pointed out that the height values of essential oil, fresh weight, dry weight chlorophyll content, plant height and root length were observed when the basil plants sprayed with 6 lit/ Humic acid.

In addition, active dry yeast is a natural safety bio fertilizer that causes various promoted effect on plants. it is considered as a natural source of cytokinines which simulates cell division and enlargement, as well as the synthesis of protein, nucleic acid and B-vitamin (Ezz El-Din and Hendawy,2010). It also releases $CO_2$ which reflected in improving net photosynthesis. Mohamed *et al*, (2017), demonstrated that yeast extracts as application increased the growth, oil yield of basil plants.

Therefore, the objective of the present study was to study the effect of Humic acid and dry yeast extracts to compensate the amount of NPK fertilizers on vegetative growth, oil yield and the chemical composition of essential oil of *Ocimum basilicum* L.

## MATERIALS AND METHODS

The present work was carried out during 2019 and 2020 seasons at the Experimental Lathe-house, Fac. Tech.& Develop., Zagazig Univ., to evaluate to what extent can use Humic acid and/ or active dry yeast applications instead of NPK chemical fertilization for enhancing vegetative growth, herb yield and essential oil yield and its components.

Seeds were sown on the 4$^{th}$ and 5$^{th}$ march 2019 and 2020, respectively, in seed trays. After one month from sowing, when the seedling reached 8-10cm height with 6-8 leaves, they were transplanted to 30cm media of clay, sand, peat moss (1:1:1) in pots with diameter of 25 cm (Table,1).

**Table (1):** The Physical and Chemical proprieties of the soil media

| **Characters** | | | |
|---|---|---|---|
| **Physical proprieties** | **Values %** | **Chemical analysis** | **Values %** |
| Coarse sand | 6.91 | Total Nitrogen | 0.33 |
| Fine sand | 8.66 | Total Phosphorus | 0.16 |
| Clay | 52.12 | Total Potassium | 0.25 |
| Silt | 28.22 | organic matter | 2.44 |
| Peat moss | 4.07 | Ca $CO_3$ | 0.55 |
| Textural class | Clay loam | pH | 7.66 |
| | | Ec (ds/m) | 0.66 |

Herb harvest was taking place twice, in the first cut, when inflorescence shoots occurred (50% flowering) in June and after two months, the second cut harvest was done.

The first cut time, the plant height of 6-7 cm above the ground, and the second cut, all the plants were harvested with the roots.

The experimental layout was split plot design for arrangement of pots with three replications, where the main plots were NPK fertilizer levels, and the Humic acid and active dry yeast (Bio-stimulants) were distributed in the sub-plots. Each replicate contained 18 treatments (3 NPK levels + 6 Humic acid and dry yeast rates), and five plants were used as an experimental unit (Snedecor and Cochran, 1989). The NPK chemical fertilizer tested levels were 0, 2.5 and 5g/ pot, (kristalon, NPK 19:19:19). These amounts were applied at the media of the pot soil, three times, after 3, 6 weeks and the third one after the first cut from transplanting (June). The three tested of NPK level used equally to zero, 50, and 100%, respectively of the recommended NPK fertilizer dose of sweet basil according to El- Sayed *et al.* (,2015). Humax 95-WGS, was used as a source of Humic acid (Table,2-a) , and yeast solution was prepared according to the method described by Morsi *et al*., (2008) and it activated overnight in 20% sucrose aqueous solution before treatments (Table, 2-b).

The tested of bio-stimulants were applied four times as foliar sprays. The first spray was added at 30 days after transplanting and the second spray was applied after 21 days from the first one. As well as, the third and fourth sprays were added at 15 and 30 days from the first cut.
The six sprays with the tested bio-stimulants as follows:

**Table (2-a): Characteristics of Humic acid used in the experiment**

| Trade name | Fulic acid | K2O | Humic acid |
|---|---|---|---|
| **Humax 95 –WGS** | 15 % | 5 % | 80 % |

Tab**le (2- b): Chemical analysis of activity dry yeast**

| Characters | Value % |
|---|---|
| Protein | 34.87 |
| Ash | 7.55 |
| Glycogen | 6.54 |
| Fats | 2.09 |
| Calluses | 4.92 |

**Table (3):** Chemical analysis of irrigation water (Tap water)

| Characters | | | |
|---|---|---|---|
| **Soluble cautions** | **Value mg/ L** | **Soluble anions** | **Value mg/ L** |
| $Ca^{++}$ | 10.10 | $HCO_3^-$ | 9.35 |
| $Mg^{++}$ | 13.32 | $SO_4^-$ | 15.10 |
| $Na^+$ | 39.40 | $CL^-$ | 19.50 |
| $K^+$ | 1.17 | pH | 7.20 |
| | | EC (dsm-1) | 5.54 |

1-Tap water (without any stimulants as control) (Table,3).
2-Humic acid at 2.5 and 5.0 g/ L.
3-Activated dry yeast at 8.0 and 12.0 g/ L.
4- Humic acid at 2.5 g/ L + Activated dry yeast at 8.0 g/ L.
The following data were recorded:

***Growth characteristics:***

The vegetative growth parameters were included; (plant height (cm), number of branches, and leaves, leaf area ($cm^2$), herbs fresh and dry weights (g).

***Chemical constituents:***

a) **Chlorophyll content**: The chlorophyll content (a, b and a+ b) of fresh leaves, as well as, total carotenoids of the two cutting times, and was measured according to the method described by. A. O. A. C. (2000).

b) **The essential oil**: it was extracted by water distillation method according to Novak *et al*., 2002. The amount of the obtained oil from the plants was measured and oil percentage (%) was calculated according to Charles and Simon, (1990).

c) **Chemical composition of basil leaves** (N, P and K): The percentage of nitrogen, phosphorus and potassium were determined in basil herb herbs at the flowering stage at the two cutting times according the methods described by A.O.A.C. (1980).

***Statistical analysis:***

Data were statistically analyzed according to Snedecor and Cochran, (1989). The Least Significant Difference (LSD) at $P \leq 0.05$ was employed to separate the treatments means using the SAS program (2004).

## RESULTS AND DISCUSSION

***Vegetative growth characters:***

***a) Effect of NPK fertilizers:***

Data in Tables (4 - 5) show that the vegetative growth of basil plants*, i.e.,* plants height, number of (branches, and leaves), herb (fresh, and dry weights), were significantly increased with NPK fertilizer in both cutting times and growing seasons compared with untreated plants.

With increasing the level of NPK from 2.5 g/ pot to 5.0 g/ pot decrease the vegetative growth characters, where treated the basil plants with 2.5 g/ pot, being the most effective in this respect.

Respecting the role of N, P and K nutrients on plants, Edmond *et al*., 1981, concluded that nitrogen is an indispensable elementary constituent of numerous organic compounds of general impotence (amino acid, protein, and nucleic acid), which are needed in the formation of protoplasm and new cells, thus increased plant growth, fresh and dry weight of different parts of plant.

Moreover, Bidwell (1979) illustrated that phosphorus plays a vital role in the enzyme system for the energy transform in photosynthesis and respiration. It is also a constituent of cell nucleus and essential for cell division and for the development of meristem tissues. Mohamed *et al*., (2017), demonstrated that potassium is the prevalent cation in plant and may be involved in maintenance

**Table (4):** Effect of NPK and Bio stimulants on vegetative growth of basil plant during the growing seasons ( 2019 and 2020)

| Treatments | | | Plant height (cm) | | Number of Branches | | Number of Leaves | |
|---|---|---|---|---|---|---|---|---|
| | | | Cuts | | | | | |
| | | | First | Second | First | Second | First | Second |
| **2019** | | | | | | | | |
| **NPK g/ pot** | | **0.0 (control)** | 38.338 | 41.916 | 9.600 | 10.200 | 168.338 | 224.916 |
| | | **2.5** | 41.905 | 45.950 | 10.011 | 10.700 | 222.683 | 248.666 |
| | | **5.0** | 40.788 | 43.188 | 9.922 | 10.550 | 202.988 | 241.083 |
| **LSD (0.05)** | | | **0.221** | **0.201** | **0.148** | **0.143** | **1.408** | **1.644** |
| **Bio stimulants** | **Humic acid g/ L** | **0.0** | 34.011 | 36.855 | 7.677 | 8.544 | 143.988 | 172..072 |
| | | **2.5** | 38.488 | 40.500 | 8.611 | 9.366 | 194.344 | 228.389 |
| | | **5** | 42.066 | 44.711 | 10.633 | 11.000 | 217.488 | 250.056 |
| | **Yeast extract g /L** | **8.0** | 41.100 | 42.911 | 9.433 | 10.433 | 203.888 | 238.689 |
| | | **12.0** | 42.655 | 47.466 | 11.177 | 11.455 | 225.744 | 263.178 |
| | **Humic acid + yeast extract g/ L** | **2.5 + 8.0** | 43.744 | 49.666 | 11.633 | 12.100 | 238.766 | 276.944 |
| **LSD at (0.05)** | | | **0.313** | **0.284** | **0.210** | **0.202** | **.992** | **2.325** |
| **2020** | | | | | | | | |
| **NPK g/ pot** | | **0.0 (control)** | 39.538 | 43.216 | 10.00 | 10.800 | 192.238 | 229.716 |
| | | **2.5** | 43.105 | 47.250 | 10.411 | 11.300 | 228.683 | 253.466 |
| | | **5.0** | 41.988 | 44.488 | 10.322 | 11.150 | 208.888 | 245.883 |
| **LSD (0.05)** | | | **0.221** | **0.201** | **0.148** | **0.143** | **1.408** | **1.644** |
| **Bio stimulants** | **Humic acid g/ L** | **0.0** | 35.211 | 38.155 | 8.077 | 9.144 | 149.888 | 176.878 |
| | | **2.5** | 39.688 | 41.800 | 9.011 | 9.966 | 200.244 | 233.189 |
| | | **5** | 43.266 | 46.011 | 10.933 | 11.600 | 223.388 | 254.856 |
| | **Yeast extract g /L** | **8.0** | 42.300 | 44.211 | 9.833 | 11.033 | 209.788 | 243.489 |
| | | **12.0** | 43.856 | 48.766 | 11.577 | 12.055 | 231.644 | 267.978 |
| | **Humic acid + yeast extract g/ L** | **2.5 + 8.0** | 44.944 | 50.966 | 12.033 | 12.700 | 244.666 | 281.744 |
| **LSD at (0.05)** | | | **0.313** | **0.284** | **0.210** | **0.202** | **1.992** | **2.325** |

**Table (5):** Effect of NPK and Bio stimulants on fresh and dry weight of basil plant during the two growing seasons (2019 and 2020)

| Treatments | | | Weight of leaves (g) | | | |
|---|---|---|---|---|---|---|
| | | | Fresh | | Dry | |
| | | | Cuts | | | |
| | | | First | Second | First | Second |
| **First season (2019)** | | | | | | |
| NPK g / pot | | 0.0 (control) | 14.148 | 15.683 | 3.610 | 5.348 |
| | | 2.5 | 14.502 | 18.672 | 4.517 | 6.422 |
| | | 5.0 | 14.393 | 18.322 | 4.310 | 5.464 |
| LSD at (0.05) | | | **0.115** | **0.082** | **0.031** | **0.038** |
| Bio stimulants | Humic acid g/L | 0.0 | 13.398 | 14.355 | 3.272 | 4.405 |
| | | 2.5 | 13.406 | 15.798 | 3.997 | 5.531 |
| | | 5 | 14.493 | 16.781 | 4.243 | 5.978 |
| | Yeast extract g /L | 8.0 | 14.094 | 16.642 | 4.074 | 5.791 |
| | | 12.0 | 14.995 | 20.330 | 4.560 | 6.117 |
| | 2.5 Humic acid +8.0 yeast extract g / L | | 15.700 | 21.458 | 4.727 | 6.647 |
| LSD at (0.05) | | | **0.163** | **0.116** | **0.044** | **0.054** |
| **Second season (2020)** | | | | | | |
| NPK g / pot | | 0.0 (control) | 16.448 | 17.588 | 4.100 | 5.928 |
| | | 2.5 | 16.693 | 20.572 | 5.007 | 7.002 |
| | | 5.0 | 16.693 | 20.222 | 4.800 | 6.044 |
| LSD at (0.05) | | | **0.115** | **0.082** | **0.031** | **0.038** |
| Bio stimulants | Humic acid g/L | 0.0 | 15.698 | 16.255 | 3.762 | 4.985 |
| | | 2.5 | 15.706 | 17.698 | 4.487 | 6.111 |
| | | 5.0 | 16.793 | 18.681 | 4.733 | 6.558 |
| | Yeast extract g /L | 8.0 | 16.394 | 18.542 | 4.564 | 6.371 |
| | | 12.0 | 17.295 | 22.230 | 5.050 | 6.697 |
| | 2.5 Humic acid +8.0 yeast extract g / L | | 18.000 | 23.358 | 5.217 | 7.227 |
| LSD at (0.05) | | | **0.163** | **0.116** | **0.044** | **0.054** |

of balance in cells and in bounds ironically to the enzyme pyruvate kinase, which is essential in respiration and carbohydrates metabolism. Moreover, it has a beneficial effect of water consumption.

***b) Effect of bio stimulants:***

It is clearly evident from data in Tables (4 - 5) that spraying basil plants with bio stimulants had a significantly increased in vegetative growth parameters compared with control treatment, in both growing seasons and cutting times. The treatment of 2.5g humic acid + 8g dry yeast/ L, being the most effective in vegetative growth characters of basil plant, followed by the treatment of 12g dry yeast/ L, and 5.0g Humic acid/ L, respectively.

As the role of humic acid, and dry yeast on basil plants, Thygesen *et al*., (2009), stated that humic substances are natural organic compounds exists in soils having high level of organic matters. In addition, humic acid a natural polymer organic compound and is one of the major components of humus and containing most of known trace minerals necessary to plant growth (El Ziat *et al*., 2018). As well as, Amer, (2004), confirmed that active dry yeast is a natural safety bio fertilizer and bio-stimulant causes various promoted effects on plants.

It is considered as a natural source of cytokinins that simulate, cell division and enlargement, as well as, the synthesis of protein, nucleic acid and B-vitamin, consequently, enhanced the plant growth. Similar trends were also registered by El-Ziat *et al*., 2018, who working with NPK, Humic acid and dry yeast, respectively. They observed that NPK, Humic acid and dry yeast application increased plant growth characters.

***Chemical and pigments constituents of basil plant:***

**a) Effect of NPK fertilizer:**

It can be seen from the data in Table (6 - 8) that application of NPK fertilization reflected a significant difference on chemical contents of herb plants (N, P, K and total carbohydrates) and pigments (chlorophyll a, b, a+ b, and carotenoids) than un applied plants in both growing seasons and both cutting times.

It is obvious from such data that applying basil plants with 2.5 g/ pot gave the highest chemical contents and pigments in plants and recorded the maximum values of N, P, K, carbohydrates, chlorophyll a, b, (a + b), and carotenoids. The lowest values of chemical and pigments contents were recorded by the untreated plants 9 control treatment). On the other hand, with increasing the level of NPK up to 5.0 g/ L., caused a decrease

**Table (6):** Effect of NPK fertilizer and bio stimulants on chlorophyll content (mg/g F.W.) of basil plant during the second season (2020)

| Treatments | | | Chlorophyll | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | A | B | a+ b | A | b | a+ b |
| | | | First cut | | | Second cut | | |
| NPK g/ pot | 0.0 (control) | | 0.835 | 0.567 | 1.403 | 0.880 | 0.474 | 1.354 |
| | 2.5 g/ pot | | 1.129 | 0.604 | 1.733 | 1.236 | 0.493 | 1.729 |
| | 5.0 g/ pot | | 0.856 | 0.583 | 1.440 | 1.050 | 0.495 | 1.546 |
| LSD (0.05) | | | **0.002** | **0.001** | **0.002** | **0.001** | **0.001** | **0.002** |
| Bio stimulants | 0.0 (control) | | 0.765 | 0.535 | 1.301 | 0.795 | 0.438 | 1.234 |
| | Humic acid g/ L | 2.5 | 0.914 | 0.566 | 1.480 | 1.061 | 0.479 | 1.541 |
| | | 5.0 | 0.984 | 0.590 | 1.575 | 1.096 | 0.495 | 1.591 |
| | Yeast extract g/L | 8.0 | 0.970 | 0.582 | 1.553 | 1.087 | 0.490 | 1.578 |
| | | 12.0 | 0.995 | 0.608 | 1.604 | 1.142 | 0.508 | 1.650 |
| | 2.5 g/L Humic acid + 8.0 g /L yeast extract | | 1.012 | 0.627 | 0.640 | 1.150 | 0.513 | 1.664 |
| LSD (0.05) | | | **0.002** | **0.002** | **0.003** | **0.002** | **0.001** | **0.002** |

**Table (7):** Effect of NPK fertilizer and bio stimulants on N, P and K % of basil plant during second season (2020)

| Treatments | | | N % | | P % | | K % | |
|---|---|---|---|---|---|---|---|---|
| | | | Cuts | | | | | |
| | | | First | Second | First | Second | First | Second |
| 0.0 (control) | | | 2.461 | 2.342 | 0.244 | 0.253 | 2.107 | 2.210 |
| NPK g/ pot | | 2.5 | 2.576 | 2.827 | 0.255 | 0.300 | 2.222 | 2.379 |
| | | 5.0 | 2.500 | 2.616 | 0.247 | 0.282 | 2.158 | 2.295 |
| LSD (0.05) | | | **0.010** | **0.011** | **0.001** | **.001** | **0.009** | **0.010** |
| Bio stimulants | Humic acid g/ L | 0.0 | 1.523 | 1.597 | 0.223 | 0.244 | 1.226 | 1.361 |
| | | 2.5 | 2.386 | 2.271 | 0.234 | 0.267 | 2.236 | 2.367 |
| | | 5.0 | 2.715 | 2.803 | 0.256 | 0.287 | 2.333 | 2.437 |
| | Yeast extract g/ L | 8.0 | 2.658 | 2.677 | 0.248 | 0.279 | 2.244 | 2.39 |
| | | 12.0 | 2.865 | 2.902 | 0.261 | 0.292 | 2.442 | 2.573 |
| | 2.5 g/L Humic acid + 8.0 g / L yeast extract | | 2.924 | 3.021 | 0.269 | 0.302 | 2.495 | 2.640 |
| LSD (0.05) | | | **0.014** | **0.016** | **0.002** | **0.002** | **0.013** | **0.014** |

**Table (8):** Effect of NPK fertilizer and bio stimulants on carotene and carbohydrates contents of basil plant during the second season (2020)

| Treatments | | | Carotene | | Total Carbohydrates | |
|---|---|---|---|---|---|---|
| | | | Cuts | | | |
| | | | First | Second | First | Second |
| **0.0 (control)** | | | 0.438 | 0.405 | 9.351 | 9.500 |
| **NPK g/ pot** | | **2.5** | 0.497 | 0.453 | 11.130 | 11.278 |
| | | **5.0** | 0.463 | 0.446 | 9.598 | 9.800 |
| **LSD (0.05)** | | | **0.002** | **0.001** | **0.018** | **0.015** |
| **Bio stimulants** | **Humic acid g/ L** | **0.0** | 0.340 | 0.321 | 8.442 | 8.561 |
| | | **2.5** | 0.437 | 0.406 | 9.418 | 9.696 |
| | | **5.0** | 0.490 | 0.439 | 10.417 | 10.571 |
| | **Yeast extract g/ L** | **8.0** | 0.472 | 0.432 | 10.292 | 10.461 |
| | | **12.0** | 0.517 | 0.483 | 10.667 | 10.827 |
| | **2.5 g/L Humic acid + 8.0 g / L yeast extract** | | 0.540 | 0.527 | 10.923 | 11.056 |
| **LSD (0.05)** | | | **0.002** | **0.002** | **0.025** | **0.022** |

values in chemical and pigments contents over than of basil herb the control treatment.

The simulative effect of N, P, and K on chemical contents of basil herb and pigments too could be attributed to that N, P, and K plays a vital role in plants as follows; Edmond *et al*., 1981 concluded that nitrogen has an important role in increasing photosynthesis in plants and thus increased the total chlorophyll. Moreover, Bidwell,1979 demonstrated that phosphorus has a vital role in energy compounds and translocation the elements and tissues formation, as well as potassium is very important for translocation the carbohydrates, water balance and increasing the elements in plants part.

***b) Effect of bio-stimulants:***

The obtained data in Tables (6 -8) reveal that N, P, K, total carbohydrates, chlorophyll a, b, and (a +b) and carotenoids in basil plants were significantly increased with the plants which treated by 2.5 g Humic acid/ L. + 8.0 g active dry yeast/ L, as foliar application in both growing seasons. Regarding the effect of bio- stimulants on plants, Humic acid, and active dry yeast; Tan (2003) pointed out that Humic acid usually utilized for plant nutrition, promote the roots, it has an important role in related to its direct effect on physiological and bio processes in plant such as, the uptake of nutrients from the soil to plants.

In addition, Kurtzman and Fell (2005) and El- Naggar *et al*., (2015) assured that active dry yeast releases $CO_2$, which reflected in improving net photosynthesis, consequently increasing the pigments in plants. The results are in concurrence with those recorded by Bayat and Belopukhov (2019); who working with NPK fertilizer, Humic acid, and dry yeast, respectively. They confirmed that NPK, Humic acid and dry yeast increased the chemical contents and pigments of plants.

***Oil yield:***

**a) Effect of NPK fertilization:**

Data in Table (9) revealed that adding 2.5 NPK g/ pot, had a significant effect on oil yield of basil plants than untreated plants, in both seasons. These results are true in both cutting times and two growing seasons.

**Table (9):** Effect of NPK fertilizer and bio stimulants on oil percentage of basil plant at (2019 and 2020 seasons)

| Treatments | | | Oil percentage (2019) | | Oil percentage (2020) | |
|---|---|---|---|---|---|---|
| | | | Cuts | | | |
| | | | First | Second | First | Second |
| **0.0 (control)** | | | 0.278 | 0.314 | 0.281 | 0.320 |
| **NPK g/ pot** | | **2.5** | 0.297 | 0.329 | 0.301 | 0.336 |
| | | **5.0** | 0.286 | 0.319 | 0.290 | 0.328 |
| **LSD (0.05)** | | | **0.001** | **0.002** | **0.002** | **0.001** |
| | **0.0** | | 0.218 | 0.246 | 0.220 | 0.252 |
| **Bio stimulants** | **Humic acid g/ L** | **2.5** | 0.246 | 0.288 | 0.250 | 0.294 |
| | | **5.0** | 0.303 | 0.346 | 0.307 | 0.354 |
| | **Yeast extract g/ L** | **8.0** | 0.286 | 0.327 | 0.289 | 0.332 |
| | | **12.0** | 0.328 | 0.353 | 0.333 | 0.362 |
| | **2.5 g/L Humic acid + 8.0 g / L yeast extract** | | 0.340 | 0.363 | 0.344 | 0.373 |
| **LSD (0.05)** | | | **0.003** | **0.002** | **0.002** | **0.002** |

Respecting the role of NPK on oil yield of basil plants, the increase in oil yield was owing directly to the increase in vegetative growth (Tables, 4-5), high photosynthesis capacity expressed in leaf pigments and high N, P, and K contents in herb of basil (Tables, 6-8). These results are harmony with those reported by Novak *et al*. (2002) and Abd El – Fatah, (2017).

***b) Effect of bio-stimulants:***

The results in Table (9) demonstrated that there was a significant difference in the studied bio-stimulants on oil yield of basil plants, where the treatment of 2.5 g/L Humic acid + 8 g/L dry yeast extract as foliar spray gave the maximum value of oil yield, compared to the untreated plants.

Concerning the effect of humic acid on oil yield of basil, may be due to the role of humic acid as a source of nutrients and increasing the soil fertility (Yang *et al*., 2004 and Kalaichelvi *et al*. 2006,). Moreover, Fahramand *et al*., (2014) illustrated that humic acid increased the hormonal growth responses, mainly nature hormones like; cytokinins, auxins and gibberellins that play a vital role in enhancing the enzymatic activities of the plants, consequently, increased the oil yield of basil plants. Regarding the effect of active dry yeast in increasing the oil yield of basil plant, Tiwari *et al*., (2006) concluded that active dry yeast is capable of mobilizing nutritive elements from no usable form to usable form through biological processes, which in turn increased the yield of plants, like oil yield of basil plants.

As for this study, Tan (2003) and Kalaichelvi *et al.*, (2006) confirmed that humic acid enhancing the uptake of nutrients by acting in mobilizing nutrients and prevents its leaching which in turn decrease the use of inorganic fertilizers, besides increasing the efficiency of the fertilizers. These results are in concurrence with those recorded by Abou *Dahab et al*., (2017), who working on humic acid, and Ezz El-Din and Hendawy, (2010), who working on dry yeast.

***Conclusively****:* from this study and the obtained results, it can be concluded that the medium level of NPK at 2.5 g/ pot, 2.5 g/ L Humic acid + 8.0 g/ L dry yeast, and its interaction were recorded the highest values on plant growth characters, chemical contents, pigments, oil yield, and chemical constituents of volatile oils. As well as, the suitable rate of Humic acid and dry yeast extract can compensate the high level of NPK doses.

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# تأثير التسميد بالمركب المعدني (من النيتروجين والفوسفور والبوتاسيوم) وبعض المنشطات الحيوية على نمو ومحصول الزيت ومكوناته الكميائية لنبات الريحان الحلو.

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اجرى هذا العمل خلال موسمى 2020,2019 فى مشتل كلية التكنولوجيا والتنمية - جامعة الزقازيق لتقيم امكانية استخدام حمض الهيوميك والخميرة الجافة النشطة فى الاستعاضة عن التسميد الكيماوى لاسراع النمو الخضرى, المحصول العشبى ومحصول الزيت.

اشتملت التجربة على 18 معاملة (3معدلات سماد نتروجين – الفوسفور- البوتاسيوم, 6 معدلات من حمض الهيوميك والخميرة الجافة, واستخدمت خمس نباتات كوحدة تجربية.

استخدم الثلاث معدلات من السماد النتروجين الفوسفائى البوتاسى بالتساوى للصف, 50% ,100% , على التوالى من الجرعة الموصى بها .

كانت الست رشات للمنشطات المختبرة هى (ماء الصنبور بدون اية اضافات كمعاملة مقارنة , 2.5 جم / لتر حمض الهيوميك ,5 جم/ لتر حمض الهيوميك ,8 جم /لتر خميرة جافة نشطة ,12 جم/لتر خميرة جافة نشطة,2 جم/لتر حمض هيوميك +8جم /لتر خميرة جافة نشطة .

صممت التجربة بنظام القطع المنشقة بحيث وزعت معدلات التسميد المعدني المركب فى القطع الرئيسية بينما وزعت المنشطات الحيوية فى القطع الفرعية.

**امكن تلخيص النتائج المتحصل عليها كما يلى :**

معاملات 2.5جم NPK/ اصيص, 2.5جم/ لتر حمض هيوميك+8جم/ لتر مستخلص الخميرة الجافة، التفاعل فيما بين معاملة 2.5جم NPK/اصيص مع 2.5 جم/لتر حمض الهيوميك + 8 جم /لترمستخلص الخميرة الجافة، كانت الاكثر فاعلية على

صفات النمو الخضرى، محصول الزيت والمحتوى الكيماوى للزيوت الطيارة لنباتات الريحان الحلو، متبوعة بالمعاملات 2.5جم/لترNPK مع12جم/لتر

مستخلص الخميرة الجافة، و2.5جم/ لترNPK لكل اصيص مع5جم/ لتر حمض الهيوميك.
على التوالى فى معظم الحالات، فى ميعادى القطع لهذة الدراسة.
**التوصية:** من النتائج السابقة يمكن التوصية باستخدام جرعة تنشيطية من السماد المعدني المركب بمعدل 2.5 جرام مع الرش بمستخلص الخميرة الجافة بمعدل 12 جرام لكل لتر ماء بالاضافة 5 جرام من محلول حمض الهيوميك.

**كلمات مفتاحية :** الريحان الحلو، التسميد النتروجينى الفوسفاتى البوتاسى، حمض الهيوميك، مستخلص الخميرة الجافة- المحتوى الكيماوى لمحصول الزيت.