

# Impact of Magnetized Water, Mineral Fertilization and Potassium Forms on Cowpea Growth and Chemical Constituents

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**Abstract:** The present work was conducted at the Experimental Station Farm, Faculty of Agriculture, Mansoura University, Egypt, during the two successive summer seasons of 2016 and 2017 to investigate the impact of irrigation water (normal water - magnetized water), foliar spraying with K forms (potassium nitrate - potacrysal as a source of nano potassium fertilizer) and levels of soil mineral fertilizers (100 -75 -50 %), NPK from recommended dose and their interactions on vegetative growth and chemical contents of cowpea plants.

Obtained data cleared that irrigation with magnetized water produced the highest significant values of plant growth, chlorophylls and chemical composition contents compared to normal water treatments. Meanwhile, fertilized cowpea plants with 100% NPK from recommended dose gave the maximum values of all studied parameters. Moreover, foliar spraying with potacrysal as a nono source of potassium increased significantly all studied characters, except number of branches in the second season.

It could be recommended that irrigation cowpea plants with magnetized water, 75% NPK from the recommended dose and foliar spraying with potacrysal in order to limiting the environmental pollution and decrease costs comparing to 100% NPK.

**Keywords:** NPK levels, cowpea, potassium nitrate, magnetic water, vegetative growth and chemical contents.

## INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is a member of family fabaceae, which cultivated for local consumption either green pods or dry seeds. In Egypt the cultivated area of green cowpea were 6736 fed. producing 26319 ton with an average yield 3.907 ton/feddan, while dry cowpea was 11528 fed. which produced 1290 ton with average productivity 1.123 ton/fed. (Ministry of Agriculture 2015). Cowpea seeds are rich in protein and carbohydrate. The cowpea seeds are a nutrition component in the human diet as well as a nutritious livestock feed. The protein in seeds is rich in lysine and tryptophan amino acids compared to cereal grains.

Magnetic water technology increases CO<sub>2</sub> and H<sup>+</sup> amount in alkaline soils is similar to the addition of fertilizers (Bogatin *et al.*, 1999), reduces salt tolerance, increases quantity and quality of yield and decrease amounts of irrigation water. It improves the irrigation water quality such as surface tension, conductivity, solubility of salts and pH (Grewal and Maheshwari, 2011). Thus, magnetized water treatment increases plant metabolism in terms of photosynthesis and water uptake (Yano *et al.*, 2004). It increases minerals dissolvability and provide adequate nutrients for plant growth (Babu, 2010). In the case of plants irrigated with magnetic irrigation water, it had many advantages including; increase of germination rate, development of root and shoot systems, development of first flowers, first fruits, number of fruits, quantity and quality of yield. Doklega (2017) showed that irrigated potato with magnetic water increased significantly vegetative plant growth, chlorophylls, yield, N, P and K.

Mineral fertilizers are applied to the soil to supply plants with nutrients for healthy growth of plant, physiological processes, and crop production.

Mineral fertilization is rapidly half lost by either leaching in drainage water or by evaporation. The

problem does not only decrease losing high amounts of chemical fertilizers but also it extends to other hazardous environmental pollution and protects human health.

Potassium influence many metabolic process such as enzyme activation, osmoregulation and water balance, prevention loses of energy, stomatal movement, photosynthesis, protein and starch synthesis and translocation of sugars and starch (Prajapati and Modi, 2012). Potassium had a significant function in various physiological processes related to plant health and resistance to biotic and abiotic stress (Wang *et al.*, 2013). Abd-Elhamied and Abd El-Hady (2018) found that foliar application with potassium nitrate increased vegetative growth of tomato, chemical component, yield and its components.

Thus, this work aimed to study the effect of irrigation with magnetized water, different levels of NPK fertilizers and foliar fertilization with potassium forms on vegetative growth and chemical constituents of cowpea.

## MATERIALS AND METHODS

This study was conducted in strip split plot design with three replicates for each treatment. The experiment consists of 12 treatments: two irrigation water (normal and magnetized water) in the vertical plots, two foliar spraying with K forms (k normal – K nano) with three replicates each (in the horizontal plots) and three mineral fertilizers (100%, 75% and 50%) from the recommended dose in the sub plots. Thus, the total numbers of treatments were 36 experimental units. Seeds of cowpea (*Vigna unguiculata* L cv. Kafr El-Sheikh-1) were sown in moisture soil at 20 cm apart in hills (3-4 seed /hill) at two ridges each one (0.7 m width and 9 m length), thus the experiment unit was 12.6 m<sup>2</sup> on 20 and 25 April during the 2016 and 2017 seasons, respectively. Some physical and chemical properties of

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the experimental soil are presented in Table 1 during the two seasons.

N, P and K fertilizers were applied at the rate of 50, 75 and 100% from recommended doses by the Ministry of Agriculture and Soil Reclamation for cowpea in forms of ammonium nitrate (33.5 % N) at the level of 40 kg N/fed., superphosphate (15 % P<sub>2</sub>O<sub>5</sub>) at the level of 30kg P<sub>2</sub>O<sub>5</sub>/fed. and potassium sulfate (48 % K<sub>2</sub>O) at the level of 30 K<sub>2</sub>O/fed. A full dose of phosphorus was applied during soil preparation, while; nitrogen and potassium were added in two equal doses, before the first and second irrigation in both seasons.

Foliar application with potassium: 0.5 % in potassium nitrate (obtained from Elgomhoria Company) form as a source of normal potassium and 5 ml/L from a commercial compound potacrysal as a source of nano potassium (obtained from Bio-Nanotechnology Company and content of 36% K<sub>2</sub>O, 5% N, 5% amino acids, 2%P<sub>2</sub>O<sub>5</sub> and 2% microelements). Foliar applications applied three times 10 days interval starting after two weeks from germination.

#### Data recorded:

After 60 days from sowing ten plants were randomly taken from each plot to determine the following parameters.

#### Foliage characters:

- Plant height (cm). - Number of leaves/ plant.
- Fresh weight (g/plant). - Dry weight (g).

#### Chemical analyses of leave:

- Chlorophyll was determined as described by Goodwine (1965).

- N, P and K contents in cowpea leaves of: N content was estimated according to Jones *et al.* (1991) while, P and K were determined due to the methods described by Peters *et al.* (2003).

#### Statistical analysis:

Data were statistically analyzed according to the technique of ANOVA for factorial experiment in strip split plot design. Treatment Means were compared using the method of LSD at the probability of 5 % according to the procedure reported by Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

#### Effect of irrigation water:

Results in Tables 2, 3, and 4 show significant increments in all measured characters, *i.e.* plant height, fresh and dry weight/plant, chlorophyll a, b and total, chemical constituents *i.e.* N, P and K of the cowpea leaves with magnetic water treatment.

These results could be attributed to the change of water structure due to reducing surface tension, increasing minerals dissolvability and providing adequate nutrients for plant growth, development of roots and shoots. It increases electro conductivity, the solubility of salts and decrease pH. Moreover it plays an important role as insecticides, fungicides and herbicides, as well as, magnetized water caused increments in microorganism's number which reflected the positive effect of the aforementioned parameters. These results agree with those recorded by Abdel Nabi *et al.* (2017), Dawa *et al.* (2017) and Doklega (2017).

**Table 1:** Some physical and chemical properties of experimental soil during 2016 and 2017 seasons

| Seasons         | Mechanical analysis (%) |           |       |       | Texture class | OM (%) | SP % | T. CaCO <sub>3</sub> g/kg | EC dS.m <sup>-1</sup> 1:5 | pH (1:2.5) | Available (mg/kg soil) |      |       |
|-----------------|-------------------------|-----------|-------|-------|---------------|--------|------|---------------------------|---------------------------|------------|------------------------|------|-------|
|                 | Coarse Sand             | Fine Sand | Silt  | Clay  |               |        |      |                           |                           |            | N                      | P    | K     |
| 1 <sup>st</sup> | 3.56                    | 26.77     | 39.02 | 30.75 | S.Cl.L        | 1.49   | 51.7 | 4.65                      | 1.16                      | 7.88       | 53.5                   | 5.19 | 181.5 |
| 2 <sup>nd</sup> | 2.91                    | 28.16     | 37.91 | 30.31 | S.Cl.L        | 1.69   | 54.5 | 3.95                      | 0.98                      | 7.95       | 56.6                   | 5.71 | 192.6 |

SP: Saturation percentage OM: Organic matter EC: Electrical conductivity  
Duncan's multiple range test

#### Effect of foliar K application:

The same Tables show the impact of foliar application with K forms either potassium nitrate or crystalon (nano compound). Treated cowpea plants with crystalon had the highest values of all parameters mentioned previously and the differences were significant except number of branches in the second season. These results may be due to potassium in form of nano material penetrate easily into leaf tissues and play rapidly its role in plant growth and development.

#### Effect of soil mineral fertilizers:

As for the impact of soil mineral NPK fertilizers, data in the same Tables show that fertilization with 100% NPK from recommended dose gave the highest values of vegetative growth parameters, chlorophyll content and chemical constituents of cowpea. The lowest values were recorded when plants were fertilized with 50% NPK and the differences were significant both seasons of the

study. These results may be due to the important role of nitrogen in plants. N is a major component of proteins, co-enzymes and nucleic acids, phosphorus also has a role in N<sub>2</sub> fixation and increase photosynthesis, While, potassium activates some enzymes and play an important role in regulating the opening and closing of stomata. These results agree with those recorded by Abdel Nabi *et al.* (2017), Doklega and Abd El-Hady (2017) and Abd El-Hady and Abd-Elhamied (2018).

#### Effect of interactions:

As for the impact of interactions treatments *i.e.* water treatments, foliar application with potassium forms and soil mineral NPK-levels data presented in Tables 5, 6, 7 and 8 show that the highest values of fresh and dry weights of plants/ g, chlorophyll a, b, total (mg/g FW.), N%, P% and K%, in leaves were recorded when plants irrigated with magnetized water and fertilized with 100% NPK from a recommended dose as well as foliar sprayed with potacrysal, it gave

superiority compared with plants were irrigated with normal water and fertilized with 100% NPK from recommended dose with potassium nitrate. Such results could be due to the roles played by every factor under

study in the impact on vegetative growth and chemical constituents as mentioned previously. These findings are in harmony with those obtained by Abdel Nabi *et al.* (2017) on head lettuce.

**Table 2:** Plant height, fresh and dry weights of plant, No. of leaves, No. of branches as affected by irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons.

| Characters                             | Plant height (cm) |       | Number of leaves/plant |       | Number of branches/plant |      | Plant fresh weight (g) |        | Plant dry weight (g) |       |
|--|-------------------|-------|------------------------|-------|--------------------------|------|------------------------|--------|----------------------|-------|
|  | 2016              | 2017  | 2016                   | 2017  | 2016                     | 2017 | 2016                   | 2017   | 2016                 | 2017  |
| <b>A- Water irrigation treatments:</b> |                   |       |                        |       |                          |      |                        |        |                      |       |
| Magnetic water                         | 79.7              | 72.2  | 34.8                   | 31.0  | 5.4                      | 6.3  | 73.1                   | 84.2   | 12.8                 | 13.6  |
| Normal water                           | 77.2              | 63.4  | 31.9                   | 24.9  | 5.1                      | 5.3  | 63.9                   | 73.4   | 10.9                 | 11.8  |
| F. test                                | *                 | *     | *                      | *     | *                        | *    | *                      | *      | *                    | *     |
| <b>B- K Form:</b>                      |                   |       |                        |       |                          |      |                        |        |                      |       |
| Potassium nitrate                      | 73.3              | 65.6  | 30.6                   | 25.8  | 5.1                      | 5.8  | 61.1                   | 70.9   | 10.9                 | 11.8  |
| Potacrysal                             | 83.6              | 70.1  | 36.1                   | 30.2  | 5.4                      | 5.7  | 75.9                   | 86.7   | 12.8                 | 13.6  |
| F. test                                | *                 | *     | *                      | *     | *                        | NS   | *                      | *      | *                    | *     |
| <b>C- Rates of NPK:</b>                |                   |       |                        |       |                          |      |                        |        |                      |       |
| 100% NPK                               | 85.2a             | 75.3a | 42.5a                  | 36.8a | 6.6a                     | 7.0a | 92.1a                  | 101.6a | 15.4a                | 16.2a |
| 75% NPK                                | 79.4b             | 67.7b | 33.5b                  | 27.6b | 5.3b                     | 5.7b | 67.5b                  | 77.5b  | 11.6b                | 12.4b |
| 50% NPK                                | 70.8c             | 60.3c | 24.0c                  | 19.7c | 3.9c                     | 4.7c | 45.9c                  | 57.3c  | 8.6c                 | 9.5c  |

**Table 3:** Chlorophyll a, chlorophyll b and chlorophylls a+b as affected by irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons

| Characters                             | Chlorophyll a (mg/g FW) |       | Chlorophyll b (mg/g FW) |       | Chlorophyll a+b (mg/g FW) |       |
|--|-------------------------|-------|-------------------------|-------|---------------------------|-------|
|  | 2016                    | 2017  | 2016                    | 2017  | 2016                      | 2017  |
| <b>A- Water irrigation treatments:</b> |                         |       |                         |       |                           |       |
| Magnetic water                         | 0.775                   | 0.737 | 0.471                   | 0.514 | 1.246                     | 1.251 |
| Normal water                           | 0.662                   | 0.702 | 0.463                   | 0.487 | 1.125                     | 1.189 |
| F. test                                | *                       | *     | *                       | *     | *                         | *     |
| <b>B- K Form:</b>                      |                         |       |                         |       |                           |       |
| potassium nitrate                      | 0.708                   | 0.707 | 0.459                   | 0.490 | 1.167                     | 1.197 |
| Potacrysal                             | 0.729                   | 0.732 | 0.474                   | 0.512 | 1.203                     | 1.244 |
| F. test                                | *                       | *     | *                       | *     | *                         | *     |
| <b>C- Rates of NPK:</b>                |                         |       |                         |       |                           |       |
| 100% NPK                               | 0.758                   | a     | 0.743                   | a     | 0.499                     | a     |
| 75% NPK                                | 0.717                   | b     | 0.721                   | b     | 0.467                     | b     |
| 50% NPK                                | 0.681                   | c     | 0.695                   | c     | 0.434                     | c     |

**Table 4:** Nitrogen, phosphorus and potassium percentages in cowpea leaves as affected by irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons

| Characters                             | N%   |      | P%    |       | K%    |      |
|--|------|------|-------|-------|-------|------|
|  | 2016 | 2017 | 2016  | 2017  | 2016  | 2017 |
| <b>A- Water irrigation treatments:</b> |      |      |       |       |       |      |
| Magnetic water                         | 3.01 | 3.16 | 0.340 | 0.369 | 2.79  | 3.03 |
| Normal water                           | 2.92 | 2.99 | 0.330 | 0.342 | 2.67  | 2.78 |
| F. test                                | *    | *    | *     | *     | *     | *    |
| <b>B- K Form:</b>                      |      |      |       |       |       |      |
| potassium nitrate                      | 2.86 | 3.00 | 0.325 | 0.348 | 2.64  | 2.79 |
| Potacrysal                             | 3.06 | 3.16 | 0.345 | 0.364 | 2.82  | 3.02 |
| F. test                                | *    | *    | *     | *     | *     | *    |
| <b>C- Rates of NPK:</b>                |      |      |       |       |       |      |
| 100% NPK                               | 3.34 | a    | 3.37  | a     | 0.375 | a    |
| 75% NPK                                | 2.97 | b    | 3.05  | b     | 0.335 | b    |
| 50% NPK                                | 2.58 | c    | 2.81  | c     | 0.295 | c    |

## CONCLUSION

In spite high values with using irrigation with magnetic water and fertilization with 100 % of recommended NPK plus foliar application with potacrysal, it could be recommended that irrigation of

cowpea plants with magnetized water, 75% NPK from the recommended dose and foliar spraying with potacrysal in order to limiting the environmental pollution and decrease costs comparing to 100% NPK..

**Table 5:** Plant height, No. of leaves and No. of branches as affected by interaction effect of irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons

| Characters     |                   |          | Plant height (cm) |      | Number of leaves/plant |      | Number of branches/plant |      |
|----------------|-------------------|----------|-------------------|------|------------------------|------|--------------------------|------|
|                |                   |          | 2016              | 2017 | 2016                   | 2017 | 2016                     | 2017 |
| Magnetic water | potassium nitrate | 100% NPK | 82.0              | 77.0 | 41.0                   | 37.0 | 6.7                      | 7.7  |
|                |                   | 75% NPK  | 75.0              | 70.0 | 33.0                   | 29.3 | 5.0                      | 6.3  |
|                |                   | 50% NPK  | 67.0              | 62.0 | 23.0                   | 19.7 | 4.0                      | 5.0  |
|                | Potacrysal        | 100% NPK | 92.7              | 83.7 | 49.7                   | 43.3 | 7.0                      | 7.7  |
|                |                   | 75% NPK  | 85.7              | 73.7 | 36.0                   | 32.0 | 5.7                      | 6.7  |
|                |                   | 50% NPK  | 76.0              | 67.0 | 26.3                   | 25.0 | 4.3                      | 4.7  |
| Normal water   | potassium nitrate | 100% NPK | 77.7              | 67.7 | 36.0                   | 31.0 | 6.3                      | 6.7  |
|                |                   | 75% NPK  | 74.3              | 62.7 | 30.0                   | 22.0 | 5.0                      | 4.7  |
|                |                   | 50% NPK  | 64.0              | 54.0 | 20.3                   | 16.0 | 3.3                      | 4.7  |
|                | Potacrysal        | 100% NPK | 88.3              | 73.0 | 44.0                   | 35.7 | 6.3                      | 6.0  |
|                |                   | 75% NPK  | 82.7              | 64.7 | 35.7                   | 27.0 | 5.3                      | 5.3  |
|                |                   | 50% NPK  | 76.3              | 58.3 | 26.3                   | 18.0 | 4.0                      | 4.3  |
| LSD            |                   |          | NS                | NS   | NS                     | 8.9  | NS                       | NS   |

**Table 6:** Plant fresh weight and plant dry weight as affected by interaction effect of irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons

| Characters     |                   |          | Plant fresh weight (g) |       | Plant dry weight (g) |      |
|----------------|-------------------|----------|------------------------|-------|----------------------|------|
|                |                   |          | 2016                   | 2017  | 2016                 | 2017 |
| Magnetic water | potassium nitrate | 100% NPK | 83.7                   | 94.3  | 14.6                 | 15.7 |
|                |                   | 75% NPK  | 63.3                   | 74.0  | 12.1                 | 13.0 |
|                |                   | 50% NPK  | 45.0                   | 55.7  | 8.9                  | 9.3  |
|                | Potacrysal        | 100% NPK | 109.7                  | 120.3 | 17.9                 | 18.5 |
|                |                   | 75% NPK  | 80.0                   | 91.3  | 12.7                 | 13.8 |
|                |                   | 50% NPK  | 56.7                   | 69.7  | 10.8                 | 11.6 |
| Normal water   | potassium nitrate | 100% NPK | 81.3                   | 87.7  | 13.3                 | 13.8 |
|                |                   | 75% NPK  | 60.3                   | 69.7  | 10.4                 | 11.0 |
|                |                   | 50% NPK  | 32.7                   | 44.3  | 6.3                  | 7.9  |
|                | Potacrysal        | 100% NPK | 93.7                   | 104.0 | 15.9                 | 16.7 |
|                |                   | 75% NPK  | 93.7                   | 75.0  | 11.3                 | 12.1 |
|                |                   | 50% NPK  | 49.3                   | 59.7  | 8.3                  | 9.1  |
| LSD            |                   |          | NS                     | NS    | NS                   | NS   |

**Table 7:** Chlorophyll a, Chlorophyll b and Chlorophyll a+b in cowpea leaves as affected by interaction effect of irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons

| Treatments   |                   | Characters | Chlorophyll a<br>(mg/g FW) |                   | Chlorophyll b<br>(mg/g FW) |       | Chlorophyll a+b<br>(mg/g FW) |       |
|--------------|-------------------|------------|----------------------------|-------------------|----------------------------|-------|------------------------------|-------|
|              |                   |            | 2016                       | 2017              | 2016                       | 2017  | 2016                         | 2017  |
|              |                   |            | Magnetic water             | potassium nitrate | 100% NPK                   | 0.798 | 0.783                        | 0.493 |
| 75% NPK      | 0.761             | 0.717      |                            |                   | 0.462                      | 0.501 | 1.223                        | 1.218 |
| 50% NPK      | 0.729             | 0.701      |                            |                   | 0.432                      | 0.482 | 1.161                        | 1.183 |
| Potacrysal   | 100% NPK          | 0.837      |                            | 0.780             | 0.510                      | 0.549 | 1.347                        | 1.329 |
|              | 75% NPK           | 0.782      |                            | 0.735             | 0.480                      | 0.529 | 1.262                        | 1.264 |
|              | 50% NPK           | 0.744      |                            | 0.727             | 0.447                      | 0.510 | 1.191                        | 1.237 |
| Normal water | potassium nitrate | 100% NPK   | 0.688                      | 0.715             | 0.490                      | 0.501 | 1.178                        | 1.216 |
|              |                   | 75% NPK    | 0.655                      | 0.698             | 0.454                      | 0.484 | 1.109                        | 1.182 |
|              |                   | 50% NPK    | 0.619                      | 0.670             | 0.422                      | 0.457 | 1.041                        | 1.127 |
|              | Potacrysal        | 100% NPK   | 0.708                      | 0.733             | 0.505                      | 0.510 | 1.213                        | 1.243 |
|              |                   | 75% NPK    | 0.672                      | 0.715             | 0.470                      | 0.500 | 1.142                        | 1.215 |
|              |                   | 50% NPK    | 0.633                      | 0.681             | 0.437                      | 0.472 | 1.070                        | 1.153 |
| LSD          |                   |            | NS                         | NS                | NS                         | NS    | NS                           | NS    |

**Table 8:** Nitrogen, phosphorus and potassium percentages in cowpea leaves as affected by interaction effect of irrigation water treatments, foliar application with K forms and soil mineral NPK-levels 2016 and 2017 seasons

| Treatments   |                   | Characters | N (%)          |                   | P (%)    |       | K (%) |       |
|--------------|-------------------|------------|----------------|-------------------|----------|-------|-------|-------|
|              |                   |            | 2016           | 2017              | 2016     | 2017  | 2016  | 2017  |
|              |                   |            | Magnetic water | potassium nitrate | 100% NPK | 3.30  | 3.35  | 0.371 |
| 75% NPK      | 2.90              | 3.05       |                |                   | 0.332    | 0.364 | 2.71  | 2.89  |
| 50% NPK      | 2.51              | 2.80       |                |                   | 0.289    | 0.328 | 2.30  | 2.55  |
| Potacrysal   | 100% NPK          | 3.52       |                | 3.56              | 0.391    | 0.409 | 3.25  | 3.55  |
|              | 75% NPK           | 3.11       |                | 3.23              | 0.348    | 0.379 | 2.90  | 3.14  |
|              | 50% NPK           | 2.69       |                | 2.99              | 0.309    | 0.345 | 2.51  | 3.76  |
| Normal water | potassium nitrate | 100% NPK   | 3.19           | 3.25              | 0.359    | 0.355 | 2.98  | 3.05  |
|              |                   | 75% NPK    | 2.84           | 2.89              | 0.318    | 0.336 | 2.58  | 2.67  |
|              |                   | 50% NPK    | 2.44           | 2.63              | 0.282    | 0.308 | 2.18  | 2.30  |
|              | Potacrysal        | 100% NPK   | 3.36           | 3.33              | 0.380    | 0.381 | 3.16  | 3.25  |
|              |                   | 75% NPK    | 3.02           | 3.02              | 0.340    | 0.351 | 2.79  | 2.94  |
|              |                   | 50% NPK    | 2.66           | 2.82              | 0.300    | 0.322 | 2.36  | 2.47  |
| LSD          |                   |            | 0.14           | NS                | NS       | NS    | NS    | NS    |

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## تأثير الري بالماء الممغنط والتسميد المعدني الارضى وبعض صور البوتاسيوم على النمو والتركييب الكيماوى للوبيا

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أجريت تجربتان حقليتان خلال الموسمين الصيفيين لعامي 2016-2017 في المزرعة البحثية بكلية الزراعة جامعة المنصورة لدراسة تأثير الري (ماء عادي - ماء ممغنط) والرش بصور مختلفة من البوتاسيوم (نترات بوتاسيوم - بوتاكريستال مصدر للبوتاسيوم النانو) ومستويات مختلفة من التسميد المعدني الأرضي (100%، 75% و 50 % من الكمية الموصى بها من النتروجين والفوسفور والبوتاسيوم) وكذلك التفاعل بينهما على صفات النمو الخضري، المحتوى الكيماوى لنبات اللوبيا.

وقد أوضحت النتائج أن الري بالماء الممغنط أدى الى زيادة معنوية في صفات النمو الخضري والكلورفيل والمحتوى الكيماوى مقارنة بالماء العادي ، بينما تسميد اللوبيا بمعدل 100 % من الكمية الموصى بها من النتروجين والفوسفور والبوتاسيوم أعطى أعلى القيم في جميع الصفات السابقة محل الدراسة. كما أدى رش اللوبيا بمركب البوتاكريستال كمصدر للبوتاسيوم النانو الى زيادة معنوية في معظم الصفات المدروسة ما عدا عدد الأفرع في الموسم الثاني.

لذلك يمكن التوصية برى نباتات اللوبيا بالماء الممغنط والتسميد بمعدل 75 % من الكمية الموصى بها للتسميد المعدني من النتروجين والفوسفور والبوتاسيوم والرش بالبوتاكريستال لتقليل التلوث البيئي وتخفيض تكاليف الانتاج الزراعي مقارنة بالتسميد بمعدل 100% من الكمية الموصى بها.