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# EFFECT OF CULTAR ON GROWTH AND PRODUCTION OF TWO CULTIVARS OF RANUNCULUS PLANT UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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## Abstract

The experiment was conducted in one of the research stations affiliated to the college of Agricultural Engineering Sciences - University of Baghdad-Aljadriyah. To study the effect of the cultar growth regulator on growth and production of two cultivars of Ranunculus plant in pots, The experiment was conducted according to the NISTD design which included three factors: three concentrations of cultar (0, 5, 10 $mg.L^{-1}$), two different cultivars of Ranunculus plant (Magic and viprant) were planted in three different environments: (open field, shading with plastic nets 60%, greenhouse) With three replicates each of them included nine plants in the experimental unit. The spraying of the growth regulator cultar was applied three times first spray when the plant reaches the stage 4-6 real leaves. And the second after one month of the first spray and the third during the formation of floral buds stage. The results showed that the cultar at concentration of 10 $mg.L^{-1}$ was superior in reduced the plant height and increased the flowers number per plant and gave the longest flowering period. While the concentration of 5 $mg.L^{-1}$ was superior by giving the highest quantity of chlorophyll, carbohydrates and number of tuberous roots. Also the plastic net environment was characterized by giving the longest plant height, the largest diameter of plant spreading, leaves content of chlorophyll, carbohydrates, the number of flowers per plant, the longest flowering period reached 37.98 days, and the number of roots forming reached 1.853 tuberous $root.plant^{-1}$.

In terms of the cultivars, the orange cultivar gave the highest values in plant height, diameter of plant spreading, quantity of carbohydrates, number of flowers and flowering period. The white cultivar also gave the highest leaves content of chlorophyll and tuberous roots. The plants treated with concentration 10 $mg.L^{-1}$ with orange cultivar that planted in plastic net environment were superiors by giving the highest number of flowers and longest period of flowering, as well as the triple interaction treatment of plants treated with a concentration 10 $mg.L^{-1}$ with orange cultivar under the environment of greenhouse were superior in increase of carbohydrates quantity. also the triple interaction treatment of plants treated with a concentration of 5 $mg.L^{-1}$ with white cultivar under the plastic net environment gave the larger quantity of chlorophyll, while the control treatment plants of orange cultivar under the plastic net environment gave the highest plant height, and the treatment of control of the white cultivar under the plastic net environment gave the largest of plant spreading diameter.

***Keywords*** **:** *Ranunculus asiaticus*, cultar, chlorophyll, environmental conditions.

## Introduction

The ranunculus plant (*Ranunculus asiaticus*) belongs to the Ranunculaceae family and dicotyledons plants. It is one of the annual flowering bulbs. The height of the plant is about 45 cm. It is known by many names such as the garlic, anemone, buttercup, Persian, celery flower and other (Ricard, 2011).

The growth regulator cultar (Pacloburazol), and its trade name Bonzi is one of the growth inhibitor discovered in 1976 belongs to the trizoles group, which are one of the largest groups of effective growth inhibitors, as it affects at low concentrations in many plant species (Mdar and Massdep, 2012).

The importance of the growth regulator Pacloburazol has an effective role in inhibiting the creation of the gibberellic acid and thus inhibit the plant growth without any detrimental effect on the morphological form of plant. The growth inhibitors such as Cycocel, Ancymidol, Alar, etc. have been used in the production of potted plants for high quality flower production, as well as for the replacement when cutting apical tips and the promotion of side branching. (Gopi *et al*., 2009).

The lighting is one of the main and important factors that directly influence many of the biological processes in plants through their effect on the phases of light reactions of photosynthesis, as well as the effect on the activity of some enzymes, and also indirectly affect some of the thermal properties of plant tissues. In general, the increase and decrease in light intensity from the normal rates which needed by the plant may adversely affect these vital activities, as this high percentage is harmful to the plant tissues by its effect in the destruction of chlorophyll pigments and thus reduce the process of photosynthesis. The decrease in intensity of light from the required rate leads to the reduction of growth and plants development through the effect on the compensation point. which is defined as the point at which the output of photosynthesis is equal to what is lost during the respiration process from the $CO_2$ compound (Fitter and Hay, 2002 and Anderson, 2012).

Numerous studies have been conducted using growth inhibitors to produce dwarf ornament plants. Fadhil (2018), during a study to produce potted plants through the effect of growth inhibitor Pacloburazol, using three concentrates (0, 50, 100 $mg.L^{-1}$) by sprinkling them on vegetable parts of *Antirrhinum majus* plant . the results showed that Pacloburazol at concentration 50 $mg.L^{-1}$ gave a significant increase in the number of flowers per plant. Also Sibel (2009) showed that the treatment of the *Consolida orientalis* plant with Pacloburazol at concentrations (0, 125, 250, 500 $mg.L^{-1}$) by spraying on the vegetative parts of plant leads to significant differences among used concentrations. and the concentration of 500 $mg.L^{-1}$ gave lowest plant height and caused an increase of stem diameter and decrease of plant leaf area.

Bekheta *et al*. (2008) reported that the spraying of *Gerbera jamesonii* with Pacloburazol at concentrations of 0, 25, 50, 100 $mg.L^{-1}$, the concentration of 100 $mg.L^{-1}$ leads to decrease of plant height to 44 cm compared to the control treatment that gave 57.5 cm. In a study of Pinto *et al* (2005) in order to production of potted plants of Zinnia plant (Lilliput) cultivar using pacloburazol with 40 $ml.pot^{-1}$ added

with irrigation water at concentrations 0.5 and 0.75 and 1.0 mg.$L^{-1}$ during the stage of floral buds formation stage (5-3 mm), The researcher concluded that the pacloburazol reduced the height of the main stem and the length of the branches and the internodes length significantly, in addition to the increase of flowers and leaves dry weight.

Wanderley *et al.* (2014) showed that after the use of pacloburazol by spraying on the vegetative parts of orchid plant *Arundina graminifolia* at concentrations 0, 5, 10 and 15 mg.$L^{-1}$, there was a significant decrease in plant height of all concentrations. The lowest plant height was 30 cm at the concentration of 10 mg.$L^{-1}$, while the control treatment gave plant height reached 52 cm. In a study conducted by Ameen (2009) for the production of cutting flowers and Iris plant bulbs using growth inhibitor cultar at concentrations (0, 10, 20, 40 and 80 mg.$L^{-1}$), the results showed that treatment with concentration of 20 mg.$L^{-1}$ resulted in decrease of plant height, while the concentration of 80 mg.$L^{-1}$ has increased the number, diameter, and dry weight of bulbs.

Runkle and Heins (2002) explained that the fabrics used for shading, plastic net and colored polyethylene significantly affect the amount of light in the growth environment, resulting in physiological and morphological changes in plants, such as plant height and leaf size, as well as photosynthetic process. Also Sudhakar and Kumar (2007) showed that there is an effect of shading on growth and quantity of Heliconium plant flowers. The plant was planted under the influence of three levels of shading (0, 50, 70% shading). The results showed that the shading level 50% gave the highest values in stem length reached 30.21 cm, the peduncles length 13.21 cm and the number of flowers per plant 4.02 which was superior to other shading levels.

Al-Rubai (2013) showed that the effect of shading 50% compared to the open field on the plant. The shading worked to improve vegetative and floral characteristics such as plant height, number of leaves per plant, leaves content of chlorophyll, floral stem length, number of florets, flower diameter, vase life, vegetative and floral dry weight, bulbs number, dry weight of bulbs and bulbs diameter. Fascella *et al* (2013) noted that the leaf area of rose plants (red france cultivar) which grown in the open field under full lighting was lower than plants cultivated under environment with 50% shading.

The objective of the study is to produce potted plants through the treatment with growth regulator, as well as to know the best environment suitable for the growth of the two cultivars of Ranunculus plant.

## Materials and Methods

The experiment was conducted in one of the research stations affiliated to the college of Agricultural Engineering Sciences - University of Baghdad - Aljadriyah. To study the effect of the cultar growth regulator on growth and production of two cultivars of Ranunculus plant in pots, The experiment was conducted according to the NISTD design which included three factors: three concentrations of cultar (0, 5, 10 mg.$L^{-1}$), two different cultivars of Ranunculus plant (Magic and viprant) were planted in three different environments: (open field, shading with plastic nets 60%, greenhouse) With three replicates each of them included nine plants in the experimental unit. The spraying of the growth regulator cultar was applied three times first spray when the plant reaches the stage 4-6 real leaves. And the second after one month of the first spray and the third during the formation of floral buds stage.

**Studied characters**

1. Plant height (cm): The plant height was calculated from the soil surface to the top of the flower using the metric tape measure.
2. The diameter of spreading plant: was measured using the metric tape measure between the farthest two points of the plant, and for all plants of the experimental unit, and then extracting the rate of each replicate in treatment.
3. Leaves content of chlorophyll:

The weight of 2 g was taken from the fresh plant leaves (full growth) to estimate the total chlorophyll, then extracted using acetone 80% with the addition of calcium carbonate in order to stabilize the dye. And then the light absorption by the sample was then measured. Using a spectrophotometer on the 665 and 645 nanometers, according to the equation described by Abbas and Abbas (1992).

4. Percentage of carbohydrates in leaves (%).
5. Number of flowers (flower.plant$^{-1}$): The number of blooming flowers on each plant was calculated for all plants of the experimental unit and then according to the rate of the ranunculus plant.
6. Flowering period: The number of days of appearance of color in flowers and until the loss of their coordination value.
7. Number of tuberous roots: The number of tuberous roots grown in each experimental unit was calculated and then the rate was calculated for each treatment.

## Results and Discussion

The results of table 1 showed that the control plants were superior by giving the highest plant height reached 36.62 cm compared to the plants of treatment $C_2$, which gave the lowest plant height reached 29.37 cm. Significant differences were also observed between environments. The $S_2$ treatment gave the highest plant height reached 37.98 cm compared to the lowest plant height that obtained from the $S_3$ environment 29.26 cm. As well as the superiority of cultivar $V_2$ in the plant height that gave 33.61 cm compared to 31.19 cm obtained from cultivar V1. As for the interactions between the factors, we note that there are significant differences between them. The interaction treatment $S_2C_0$ was superior by giving the highest plant height reached 44.16 cm compared to the lowest value of plant height 26.22 cm that obtained from ($S_3C_2$). Also the interaction between the environments and cultivars was significant. the highest increase of plant height obtained from interaction treatment of $S_2V_2$ that gave 40.22 cm compared to the lowest plant height in the interaction treatment $S_3V_1$ which was 27.94 cm. As for the interaction between the cultar and the cultivars, the interaction treatment of $C_0V_2$ was superior by giving the highest plant height reached 37.80 cm compared to the lowest value of same character that obtained from interaction treatment $C_2V_1$ reached 26.48 cm.

In terms of the effect of the triple interaction among study factors in this character, we note the superiority of the

interaction treatment $S_2$ $C_0$ $V_2$, which gave a highest plant height reached 46 cm, compared to the lowest plant height which obtained from interaction treatment $S_1C_2V_1$ reached 24.33 cm.

**Table 1 :** Effect of different concentrations of Cultar in the plant height of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar (C) | Variety (V) | | S.C |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 33.64 | 33.58 | 33.61 |
| | C1 | 31.66 | 27.80 | 29.73 |
| | C2 | 24.33 | 28.76 | 26.54 |
| S2 | C0 | 42.33 | 46.00 | 44.16 |
| | C1 | 34.16 | 34.66 | 34.41 |
| | C2 | 30.72 | 40.00 | 35.36 |
| S3 | C0 | 30.33 | 33.83 | 32.08 |
| | C1 | 29.11 | 29.83 | 29.47 |
| | C2 | 24.38 | 28.05 | 26.22 |
| **LSD S.C.V** | | **1.67** | | **1.33** |
| **Variety (V)** | | **31.19** | **33.61** | |
| **LSD ( V)** | | **0.46** | | |

| Environment X Variety ( S . V ) | | | | |
|---|---|---|---|---|
| Environment ( S ) | V1 | V2 | Environment (S) | |
| S1 | 29.88 | 30.05 | 29.96 | |
| S2 | 35.74 | 40.22 | 37.98 | |
| S3 | 27.94 | 30.57 | 29.26 | |
| LSD ( S . V ) | 1.14 | | LSD (S) | 1.09 |

| Cultar X Variety ( C. V ) | | | | |
|---|---|---|---|---|
| Cultar ( C) | V1 | V2 | Cultar ( C) | |
| C0 | 35.43 | 37.80 | 36.62 | |
| C1 | 31.65 | 30.76 | 31.21 | |
| C2 | 26.48 | 32.27 | 29.37 | |
| LSD ( C . V) | 0.85 | | LSD(C) | 0.66 |

The results of Table 2 show that the cultar alone showed no significant differences in the diameter of plant spreading. While the environments showed significant differences. The $S_2$ environment gave the largest plant spreading diameter which was 29.06 cm compared to the lowest plant spreading diameter in the environment of $S_3$ treatment that reached 17cm. As for the varieties, the cultivar of $V_2$ gave the highest plant spreading diameter of 22.84 cm, compared to cultivar $V_1$ which gave 21.42 cm. As for the interaction between the study factors, significant differences can be observed between the interaction treatments of cultar concentration and the environments. The interaction treatment of $S_2C_2$ was superior in plant spreading diameter by giving the highest value reached 29.65 cm compared to the lowest value of this character that obtained from the interaction treatment of $S_3C_0$ which was 16.50 cm. It also showed the significant differences between the interaction of environments and the cultivars, the interaction treatment of $S_2V_2$ gave the largest spreading diameter of plant reached 29.59 cm although it did not differ significantly from the treatment of $S_2V_1$, compared to the lowest plant spreading diameter that obtained from interaction treatment of $S_3V_1$, which amounted to 16.73 cm. In the case of interaction between cultar and cultivars, the interaction treatment $C_2V_2$ was superior by giving the largest plant diameter reached 23.21 cm compared to the lowest plant diameter that obtained from the treatment of $C_1V_1$, which reached 20.72 cm. From the same table, also we observe that the triple interaction resulted in significant differences between the treatments. The treatment of $S_2C_1V_2$ was superior by giving the largest spreading diameter of 30.57 cm, compared to the lowest spreading diameter obtained from the treatment of $S_3C_0V_1$ which reached 15.97 cm.

**Table 2 :** Effect of different concentrations of Cultar in the diameter of plant spreading of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar | Variety | | c . v |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 20.50 | 21.94 | 21.22 |
| | C1 | 15.83 | 22.22 | 19.03 |
| | C2 | 20.66 | 20.83 | 20.75 |
| S2 | C0 | 29.54 | 27.44 | 28.49 |
| | C1 | 27.53 | 30.57 | 29.05 |
| | C2 | 28.53 | 30.77 | 29.65 |
| S3 | C0 | 15.97 | 17.04 | 16.50 |
| | C1 | 18.80 | 16.75 | 17.78 |
| | C2 | 15.42 | 18.04 | 16.73 |
| **LSD S.C.V** | | **1.67** | | **1.19** |
| **Variety (V)** | | 21.42 | 22.84 | |
| **LSD ( V)** | | **0.68** | | |

| Environment X Variety ( S . V ) | | | | |
|---|---|---|---|---|
| Environment ( S ) | V1 | V2 | Environment (S) | |
| S1 | 19.00 | 21.66 | 20.33 | |
| S2 | 28.53 | 29.59 | 29.06 | |
| S3 | 16.73 | 17.28 | 17.00 | |
| LSD ( S . V ) | 1.06 | | LSD (S) | 0.84 |

| Cultar X Variety ( C. V ) | | | | |
|---|---|---|---|---|
| Cultar ( C) | V1 | V2 | Cultar ( C) | |
| C0 | 22.00 | 22.14 | 22.07 | |
| C1 | 20.72 | 23.18 | 21.95 | |
| C2 | 21.53 | 23.21 | 22.37 | |
| LSD ( C . V) | 0.97 | | LSD(C) | N.S |

The results of table 3 indicate that the leaves content of chlorophyll was affected by the treatments of cultar. The treatment of $C_1$ was superior in this character and gave the highest value of chlorophyll quantity in the leaves reached 159.1 mg.gm$^{-1}$ fresh weight, compared to the lowest quantity of chlorophyll obtained from control treatment plants that gave 139.4 mg.gm$^{-1}$ fresh weight. As for the environment, the plastic net environment $S_2$ gave the highest value of chlorophyll in the leaves reached 163.6 mg.gm$^{-1}$ fresh weight which did not differ significantly from the environment of $S_3$, compared to the lowest chlorophyll quantity which obtained from the environment $S_1$ reached 127.5 mg.gm$^{-1}$ fresh weight. the cultivar of $V_1$ was superior by giving the largest quantity of chlorophyll 159.6 mg.gm$^{-1}$ fresh weight.

In terms of the interaction treatments, the table shows that the interaction between culter concentrations and the environments showed significant differences. The interaction treatment $S_2C_1$ was superior by giving the highest quantity of chlorophyll reached 178.6 mg.gm$^{-1}$ fresh weight but not significantly different from treatment of $S_2C_2$ compared to lowest quantity obtained from interaction treatment $S_1C_2$ which gave 120.4 mg.gm$^{-1}$ fresh weight. It also shows the interaction between environments and cultivars that the treatment of $S_2V_1$ gave the highest quantity of chlorophyll reached 181.5 mg.gm$^{-1}$ fresh weight. From the same table,

the interaction between the cultar concentrations and the cultivar showed that the treatment of $C_1V_1$ was superior compared to the other treatments with the highest chlorophyll concentration reached 175.9 mg.gm$^{-1}$ fresh weight.

As for the triple interaction of the study factors, there was a significant difference between the treatments, where we note that the superiority of the treatment of $S_2C_1V_1$ by giving the highest quantity of chlorophyll was 209.2 mg.gm$^{-1}$ fresh weight compared to the lowest value of this character obtained from the interaction treatment of $S_1C_2V_1$ which was 112.2 mg.gm$^{-1}$ fresh weight.

**Table 3 :** Effect of different concentrations of Cultar in the chlorophyll of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar | Variety | | c .v. |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 126.1 | 126.6 | 126.4 |
| | C1 | 144.8 | 126.8 | 135.8 |
| | C2 | 112.2 | 128.6 | 120.4 |
| S2 | C0 | 148.0 | 128.1 | 138.0 |
| | C1 | 209.2 | 148.0 | 178.6 |
| | C2 | 187.4 | 161.2 | 174.3 |
| S3 | C0 | 156.2 | 151.6 | 153.9 |
| | C1 | 173.7 | 152.1 | 162.9 |
| | C2 | 179 | 138.9 | 159 |
| LSD S.C.V | | 8.19 | | 6.22 |
| Variety (V) | | 159.6 | 140.2 | |
| LSD ( V) | | 3.47 | | |
| Environment X Variety ( S . V ) | | | | |
| Environment ( S ) | | V1 | V2 | Environment (S) |
| S1 | | 127.7 | 127.3 | 127.5 |
| S2 | | 181.5 | 145.8 | 163.6 |
| S3 | | 169.6 | 147.6 | 158.6 |
| LSD ( S . V ) | | 6 | | LSD (S) 5.19 |
| Cultar X Variety ( C. V ) | | | | |
| Cultar ( C) | | V1 | V2 | Cultar ( C) |
| C0 | | 143.4 | 135.4 | 139.4 |
| C1 | | 175.9 | 142.3 | 159.1 |
| C2 | | 159.5 | 142.9 | 151.2 |
| LSD ( C . V) | | 4.57 | | LSD(C) 3.03 |

The results of table 4 showed that the cultar concentrations resulted in a significant increase in leaves carbohydrate. The treatment of $C_1$ gave the highest percentage of leaves carbohydrates reached 28.80% compared to the lowest ratio obtained from $C_0$ treatment reached 25.79%. In terms of the environments, we note from the same table that environment $S_3$ gave the largest percent of carbohydrates reached 33.09%, compared to the lowest percentage that obtained from the plastic net environment $S_2$ that reached 20.02%. on the other hand, in terms of the varieties. The cultivar of $V_2$ gave the highest percentage of leaves carbohydrates reached 28.40% compared to 28.19% obtained from $V_1$ cultivar.

The results also indicate to significant differences between the interaction treatments between the cultar concentrations and the environments. The treatment of $S_3C_1$ gave the highest percentage of leaves carbohydrate 36.22% compared to the lowest percent of carbohydrates obtained from the treatment of $S_2C_1$ which gave 17.67%. while the interaction between environments and cultivars. The results indicated that the treatment of $S_3V_2$ was superior by giving the highest quantity of leaves carbohydrates reached 34.10%.

As well as the interaction between cultar concentrations and cultivars, the table shows the superiority of the treatment $C_2V_2$ that gave the highest quantity of leaves carbohydrates reached 30.25 but did not significantly differ from the treatment of $C_1V_2$ compared to the lowest percent obtained from the treatment of $C_2V_1$ amounted to 24.27%. In the same table, the triple interaction showed significant differences. The treatment of $S_3C_2V_2$ gave the highest percent of leaves carbohydrate reached 39.55% while the lowest percent obtained from treatment of $S_2C_2V_1$ and reached 14%.

**Table 4 :** Effect of different concentrations of Cultar in the carbohydrate of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar | Variety | | c .v. |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 31.60 | 27.43 | 29.52 |
| | C1 | 28.07 | 29.43 | 28.75 |
| | C2 | 26.00 | 29.87 | 27.94 |
| S2 | C0 | 19.70 | 22.25 | 20.98 |
| | C1 | 19.87 | 23.00 | 21.43 |
| | C2 | 14.00 | 21.33 | 17.67 |
| S3 | C0 | 26.90 | 26.85 | 26.88 |
| | C1 | 36.53 | 35.90 | 36.22 |
| | C2 | 32.80 | 39.55 | 36.17 |
| LSD S.C.V | | 1.61 | | 1.16 |
| Variety (V) | | 26.16 | 28.40 | |
| LSD ( V) | | 0.58 | | |
| Environment X Variety ( S . V ) | | | | |
| Environment ( S ) | | V1 | V2 | Environment (S) |
| S1 | | 28.56 | 28.91 | 28.73 |
| S2 | | 17.86 | 22.19 | 20.02 |
| S3 | | 32.08 | 34.10 | 33.09 |
| LSD ( S . V ) | | 0.92 | | LSD (S) 0.75 |
| Cultar X Variety ( C. V ) | | | | |
| Cultar ( C) | | V1 | V2 | Cultar ( C) |
| C0 | | 26.07 | 25.51 | 25.79 |
| C1 | | 28.16 | 29.44 | 28.80 |
| C2 | | 24.27 | 30.25 | 27.26 |
| LSD ( C . V) | | 0.93 | | LSD(C) 0.69 |

The results of table 5 showed that the environments significantly increased the number of flowers per plant. The $S_2$ environment gave the highest number of flowers per plant reached 4.94 flower.plant$^{-1}$ compared to the lowest number of flowers obtained from the environment $S_3$, which was 2.185 flower.plant$^{-1}$. As well as the concentrations of cultar, we note that it led to an increase in the number of flowers per plant. The treatment of $C_2$ gave the highest number of flowers per plant reached 3.828 flower.plant$^{-1}$ compared with the lowest flowers number obtained from control plants that gave 2.680 flower.plant$^{-1}$. As for the varieties, the orange variety gave the maximum number of flowers per plant reached 3,790 flower.plant$^{-1}$ compared to 2.820 flower.plant$^{-1}$ obtained from white cultivar.

In terms of the interactions between the study factors, the results of table 3 show that the interaction between the cultar concentrations and the cultivars have significant differences. The treatment of $C_2V_2$ gave the highest number of flowers per plant reached 4.537 flower.plant$^{-1}$. In addition, the interaction between the cultar concentrations and the

environments have significant differences, where the treatment of $S_2C_2$ was superior which gave 6.193 flower.plant$^{-1}$ compared to the lowest number of flowers per plant that obtained from the treatment of $S_1C_0$ and reached 2.208 flower.plant$^{-1}$. While the interaction between environments and varieties showed no significant differences.

As for the triple interaction between the study factors, the results show that the treatment $S_2C_2V_2$ was the highest in terms of number of flowers per plant, which gave 7.167 flower.plant$^{-1}$, compared to the lowest number of flowers per plant 1.833 flower.plant$^{-1}$ which obtained from treatment of $S_1C_0V_1$.

**Table 5 :** Effect of different concentrations of Cultar in the number of flowers of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar | Variety | | c .v. |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 1.833 | 2.583 | 2.208 |
| | C1 | 3.083 | 2.917 | 3.000 |
| | C2 | 2.303 | 4.000 | 3.152 |
| S2 | C0 | 3.110 | 4.333 | 3.722 |
| | C1 | 4.083 | 5.750 | 4.917 |
| | C2 | 5.220 | 7.167 | 6.193 |
| S3 | C0 | 2.083 | 2.167 | 2.125 |
| | C1 | 1.833 | 2.750 | 2.292 |
| | C2 | 1.833 | 2.443 | 2.138 |
| LSD S.C.V | | 0.802 | | 0.418 |
| Variety (V) | | 2.820 | 3.790 | |
| LSD ( V) | | 0.539 | | |

| Environment X Variety ( S . V ) | | | | |
|---|---|---|---|---|
| Environment ( S ) | V1 | V2 | Environment (S) | |
| S1 | 2.407 | 3.167 | 2.787 | |
| S2 | 4.138 | 5.750 | 4.944 | |
| S3 | 1.917 | 2.453 | 2.185 | |
| LSD ( S . V ) | N.S | | LSD (S) | 0.224 |

| Cultar X Variety ( C. V ) | | | | |
|---|---|---|---|---|
| Cultar ( C) | V1 | V2 | Cultar ( C) | |
| C0 | 2.342 | 3.028 | 2.685 | |
| C1 | 3.000 | 3.806 | 3.403 | |
| C2 | 3.119 | 4.537 | 3.828 | |
| LSD ( C . V) | 0.579 | | LSD(C) | 0.276 |

The results of table 6 showed that the cultar treatments resulted in a significant increase in the flowering period of the plant. The treatment of $C_2$ gave the longest period of flowering was 18.84 days, which was superior compared to the control plants which gave the lowest period of flowering reached 13.98 days. As for the environment treatments, they differed significantly between them. The environment of $S_2$ was the best by giving the longest flowering period of the plant reached 21.13 days, compared to the shortest period obtained from the environment of $S_3$ which gave 14.26 day. As for the cultivars, we notice significant differences between them. The orange cultivar gave the longest flowering period reached 17.28 days, compared to 16.49 days obtained from the white cultivar.

In terms of the interaction between the study factors. we note the superiority of interaction treatment of $S_2C_2$, which gave the longest period of flowering reached 24.27 days, compared to lowest period (11.78 days) which obtained from the treatment of $S_1C_0$, As for the interaction between the environments and varieties, we note the superiority of interaction treatment $S_2V_2$, which gave the longest period of flowering amounted to 22.02 days compared to lowest period of flowering 13.46 days which obtained from the interaction treatment $S_3V_2$. There was no significant difference in interaction between cultar concentrations and cultivars. Also it is noticed from the triple interaction among the study factors that the treatment of $S_2C_2V_2$ was superior compared to the other treatments, which gave the longest flowering period of 24.33 days, compared to the lowest period reached 11.31 days obtained from the treatment $S_1C_0V_1$.

**Table 6 :** Effect of different concentrations of Cultar in the flowering period of the plant of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar | Variety | | c .v. |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 11.31 | 12.25 | 11.78 |
| | C1 | 14.58 | 16.44 | 15.51 |
| | C2 | 16.66 | 20.44 | 18.55 |
| S2 | C0 | 15.97 | 17.89 | 16.93 |
| | C1 | 20.53 | 23.83 | 22.18 |
| | C2 | 24.22 | 24.33 | 24.27 |
| S3 | C0 | 14.77 | 11.66 | 13.22 |
| | C1 | 17.16 | 14.55 | 15.86 |
| | C2 | 13.22 | 14.17 | 13.69 |
| LSD S.C.V | | 1.61 | | 1.14 |
| Variety (V) | | 16.49 | 17.28 | |
| LSD ( V) | | 0.51 | | |

| Environment X Variety ( S . V ) | | | | |
|---|---|---|---|---|
| Environment ( S ) | V1 | V2 | Environment (S) | |
| S1 | 14.19 | 16.38 | 15.28 | |
| S2 | 20.24 | 22.02 | 21.13 | |
| S3 | 15.05 | 13.46 | 14.26 | |
| LSD ( S .V ) | 0.79 | | LSD (S) | 0.62 |

| Cultar X Variety ( C. V ) | | | | |
|---|---|---|---|---|
| Cultar ( C) | V1 | V2 | Cultar ( C) | |
| C0 | 14.02 | 13.93 | 13.98 | |
| C1 | 17.42 | 18.27 | 17.85 | |
| C2 | 18.03 | 19.65 | 18.84 | |
| LSD ( C .V) | N.S | | LSD(C) | 0.72 |

The results of table 7 showed that the treatments of cultar resulted in a significant increase in the number of tuberous roots. The treatment of $C_1$ was superior by giving the highest number of tuberous roots reached 1.866 tuberous root.plant$^{-1}$ which did not differ significantly from treatment $C_2$ compared to the lowest number of tuberous roots which obtained from control plants 1.454 tuberous root.plant$^{-1}$. As for the environment, we note the superiority of environment $S^2$ by giving the highest number of tuberous roots amounted to 1.853 tuberous root.plant$^{-1}$, and did not differ significantly from the environment $S_1$, compared to the lowest number of tuberous roots which obtained from the environment of $S_3$, and reached 1.516 tuberous root.plant$^{-1}$.

In terms of bilateral and triple interaction among study factors, no significant differences were observed except the interaction between the cultar concentrations and the cultivars, which indicated the superiority of the treatment $C_1V_1$, which gave the largest number of tuberous roots of 2.274 tuberous root.plant$^{-1}$, compared to the lowest number of tuberous roots which obtained from the treatment of $C_0V_2$ which reached 1.358 tuberous root.plant$^{-1}$.

**Table 7 :** Effect of different concentrations of Cultar in the number of tuberous roots of two varieties of Ranunculus growing under three different environmental conditions.

| Environment (S) | Cultar (C) | Variety (V) | | S . C |
|---|---|---|---|---|
| | | V1 | V2 | |
| S1 | C0 | 1.550 | 1.413 | 1.482 |
| | C1 | 2.497 | 1.497 | 1.997 |
| | C2 | 1.887 | 1.997 | 1.942 |
| S2 | C0 | 1.663 | 1.440 | 1.552 |
| | C1 | 2.107 | 1.553 | 1.830 |
| | C2 | 2.470 | 1.887 | 2.178 |
| S3 | C0 | 1.440 | 1.220 | 1.330 |
| | C1 | 2.220 | 1.440 | 1.830 |
| | C2 | 1.553 | 1.220 | 1.387 |
| LSD S.C.V | | N.S | | N.S |
| Variety (V) | | 1.932 | 1.519 | |
| LSD ( V) | | 0.260 | | |

| Environment X Variety ( S . V ) | | | | |
|---|---|---|---|---|
| Environment ( S ) | V1 | V2 | Environment (S) | |
| S1 | 1.978 | 1.636 | 1.807 | |
| S2 | 2.080 | 1.627 | 1.853 | |
| S3 | 1.738 | 1.293 | 1.516 | |
| LSD ( S . V ) | N.S | | LSD (S) | 0.291 |

| Cultar X Variety ( C. V ) | | | | |
|---|---|---|---|---|
| Cultar ( C) | V1 | V2 | Cultar ( C) | |
| C0 | 1.551 | 1.358 | 1.454 | |
| C1 | 2.274 | 1.497 | 1.886 | |
| C2 | 1.970 | 1.701 | 1.836 | |
| LSD ( C . V) | 0.321 | | LSD(C) | 0.199 |

## Discussion

The results of Tables (1, 3, 4, 5, 6, and 7) show that spraying of Ranunculus plant with growth inhibitor cultar resulted in significant differences compared to control treatment. The cultar works to shorten the plant may be by inhibiting the creation of gibberellic acid which is responsible for elongation of the internodes in stems, which caused the reduction of the length of internodes without affecting the number of nodes on the stem and the latter result in reducing the length of the plant (Gopi *et al.*, 2009). This is in agreement with results of (Porwel and Pander, 2004; Mishra *et al.*, 2005; Ameen, 2009; Wanderley *et al.,* 2014; Fadhel, 2018; Bekheta *et al.*, 2008; Al-Mahdawe, 2018).

Abdul and Jaleel *et al*. (2007) show that pacloburazol causes an increase in the thickness cuticle, the epidermis, the palisade layer and the spongy layer. This in turn increases the amount of chlorophyll in the leaves. the increases of chlorophyll coincides with increase of nutrients in the leaves, especially nitrogen and iron. The addition of pacloburazol to the orange seedlings caused an increase in the leaves content of chlorophyll with increased accumulation of carbohydrates in both of stem and roots (Mehouachi *et al*., 1996).

The effect of cultar on the flowers growth, this may be due to the improvement of vegetative growth (such as increasing the amount of chlorophyll and carbohydrates) Which is reflected on flowers characters such as the number of flowers per plant and the flowering period and others. This may be reflected in increasing the improvement of the characteristics of the roots such as the number of tuberous roots, its diameters and dry weight.

The increase of the flowers number and the increase of the flowering period, as well as improving the characters of the roots may be due to the role of pacloburazol in the increase of chlorophyll and carbohydrates and worked to reduce the plant height, Which means the optimal utilization of accumulated carbohydrates as well as increased nutrient uptake which was positively reflected on the flower quality (Grossman, 1990). While in terms of the effect of the agricultural environments, the results of the tables show that the studied characters were affected by the lighting factor significantly, we may note that the plant shading by 60% has positive effect on some characters of vegetative and floral growth (plant height and the diameter plant spreading) tables (1 and 2). This may be due to an increase in the percentage of internal auxins in the shaded environment compared to other environments, leading to increased elongation and division of cells, which increase the plant height and increase the diameter of plant spreading. The effect of plants shading (60%) on the floral and roots characters (tables 3, 4 and 5) may be due to its role in improving vegetative growth indicators, increasing photosynthesis and increasing carbohydrates substances in leaves, which improves the characters of floral growth and the tuberous roots characters.

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