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Research Article

THE INDEPENDENT EFFECT OF TIME AND HORMONAL CONCENTRATION TREATMENTS ON REPRODUCTIVE TRAITS IN ONION

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ABSTRACT
A factorial split plot project with randomized complete block design using three repeats was conducted in Agriculture and Natural Resources Research Center in North Khorasan Province to evaluate the effects of different treatments of gibberellin hormone concentrations (0, 250, 500 and 750 milligrams per liter) and time (0, 6, 12 and 18 hours) on vegetative growth of onion. Independent analysis of data showed that yield was not significantly influenced by the hormonal concentration in onion. However, onion had the highest yield at 500 milligrams per liter concentration of gibberellin.. Meanwhile, examining the interactive effects of these treatments on reproductive traits and yield showed that 12 hours treatment and 500 milligrams per liter hormonal concentration had the greatest impact on the number of small-sized, medium-sized and total number of onions as well as weights of small-sized and medium-sized onions. Control time treatment and 500 milligrams per liter hormonal concentration had the highest impact on the number, weights and total weight of large-sized onions.

Keywords: *Hormone, Reproductive Traits, Onion*

INTRODUCTION
Edible onion is a biennial and multi-stem plant, and its mechanized harvesting is difficult because the stems are not of the same height and the umbels do not mature at the same time.
Onion with Allium cepa L scientific name and Alliaceae family is a perennial plant, which is mainly cultivated for two years (Amin *et al.*, 2004).
Nowadays, plant growth regulators are used to speed up production time as well as production of high quality and market-friendly products by farmers and manufacturers of agricultural products. Nowadays, plant hormones are used for different purposes. Such hormones as auxin, cytokinin and gibberellin stimulate growth in different areas such as roots, stems, stimulate germination and break dormancy of seeds. Such hormones as abscisic acid inhibit growth while such others as ethylene stimulate dormancy of seeds. The latter is usually used in fridges and warehouses for maintaining fruit and other plant products in order to increase storage period. Ghibelline was used as a treatment in several studies in order to break dormancy of seeds in several experiments. Takahashi *et al.*, (1957) differed GA_4 compound from gibberella fujikuroi. They showed that the former is similar to gibberellin A, which was discovered by Stodal (1955). However, there are no similarities between GA2, GA4. McMillan and Takahashi (1968) considered certain numbers of gibberellin A_1 to A_X regardless of their origins. Waghmode *et al.*, (2010) Showed gibberellic acid, can play an effective role in improving these characteristics. Several classes of plant growth regulators affect physiological activities of the onion plant. Abscisic acid has been reported to in duce senescence on onion plants and prolongs bulb dormancy (Abdel and Isenberg, 1974) Gibberellic acid has been proposed as the anti-bulbing hormone (Shibaoka, 1991). Naumny *et al.*, (1980) reported onions treated with different concentrations of gibberellic acid in Occupied Palestine had more uniform stem height and time of umbel maturity and higher seed yields (with the 50-ppm treatment having the greatest effects). Rizk *et al.*, (1996) obtained the best result in the treatment of applying 50-ppm gibberellic acid and 100-ppm auxin, and reported that treated plants a larger average number of flowering stems and their yield was about 80% higher. In India, Singh *et al.*, (1995) soaked onion seeds in 150, 300, and 450-ppm gibberellic acid and obtained the highest seed yield in the 300-ppm treatment.

The objectives of this study were determining the optimal concentration of gibberellic acid (gibberellins) for seed treatment before planting in order to enhance reproductive traits in onions.

MATERIALS AND METHODS

The project site was located in Kohneland research farm in four kilometers West of Bojnord. This site was located 1050 m above sea level. In addition, average annual rainfall was 263 mm, absolute minimum temperature was -25°C, absolute maximum temperature was 40°C, average temperature was 13°C, altitude (east-west) was 2257 while latitude (north-south was 28 37. This station was located in the alluvial plain physiographic unit, which has a gentle slope and lacks topography, and does not erode. The land has a deep soil with medium surface texture (silty loam) and medium (loam silt) to heavy (clay loam) lower texture. Khosravani seed variety was prepared, which was ready to be planted since it was readily disinfected and winnowed. Germination power of this type of seed was 86%. Different concentrations of gibberellin hormone were prepared as follows. First, 250 mg concentration of the hormone with 99% purity was weighted using a sensitive scale. Then, it was poured into a beaker containing 100 ml of distilled water. Then, either one or two drops of normal NAOH were added. Then, the compound was mixed to dissolve gibberellin crystals. After complete dissolution of crystals, water volume was reached to 1,000 cc. Then, it was poured into a closed bottle, which was disinfected as already stated above. The solution was covered with an aluminum foil to avoid the sunlight. Then, 500 mg and consequently 750 mg of gibberellin hormone powder were isolated to obtain the required concentrations. Then, distilled water was added to the powder. Then, water volume was brought to 1000 cc. The solutions were covered with aluminum foils to avoid decomposing effect of sunlight on the obtained solution. Then, 100 ml of each concentration was isolated from labeled containers and added to 5 g of dry seeds weighed with a sensitive scale. Every 15 minutes, the solution containing gibberellin hormones and immersed seeds were blown to prevent smothering of the seeds in the solution. This action was periodically repeated in other containers. The distance between plots was (3 x 3) square meters. The plots were within 1 m from each other. The main plots were within 2 m from each other. The repeats were within 3 meters from each other, so that a worker or a weed removal device could easily remove weeds. As a result, labor costs were reduced. The distance between each row was 20cm while the distance between two rows was 40cm. Thus, planting and maintaining operations such as watering and weeding could easily be conducted in 40cm distance. Drainage irrigation was performed regularly every 7 days. Thinning operation was performed in two stages after germination of all seeds. As a result, the distance between two plants was 10 cm. Then, subsequent measurements were done easily and accurately. Then, weeding operation was carried out in three stages. The harvest was followed when following situations were observed. The lower leaves were dried. Moreover, aerial stems could no longer hold their own; as a result, they were bent to one side (with respect to the prevailing wind). Thus, two lines one meter above and one meter below the plot were removed. MSTAT-C software was used for statistical analysis in this experiment. Excel software was used to draw graphs and charts. The means were compared using Duncan's multiple range test at 1 and 5 percent probabilities.

RESULTS AND DISCUSSION

In order to evaluate the reproductive traits of onion, time treatments (0, 6, 12 and 18 hours) were considered as the major factor while different hormonal concentrations (0, 250, 500 and 750 milligrams per liter) were considered as the minor factor. The effect of these factors on reproductive traits, such as number of small-sized, medium-sized and large-sized bulb and total number of bulb per unit area as well as weights of small-sized, medium-sized and large-sized bulb was examined. The effect of time on reproductive such traits as number of small-sized, medium-sized and large-sized bulb and total number of bulb per unit area as well as weights of small-sized, medium-sized and large-sized bulb was not significant although a numerical difference was observed. However, the effect of different hormonal concentration on reproductive traits was significant at 1% (r = 0.0003) while the latter effect was significant on weight of medium-sized onion per unit area at 5%. In terms of yield, the latter effect was

not significant on large-sized onion while the effect of reproductive traits on total weight was significant at 5% level. ANOVA results considering the interactive effect of time and hormonal concentration on the number of small cubes (x <4) indicated a significant difference (ANOVA table). Thus, the interactive effect of 12-hour and 500 milligrams per liter hormonal concentration was the highest numerical value (n = 56) while the plot with 6 hours and 750 milligrams per liter hormonal concentration had the lowest numerical value. ANOVA results considering the interactive effect of time and different hormonal concentration on the number of medium-sized bulb showed that collar diameter of this bulb were between 4 and 6 cm. This difference was significant.

Table 1: Analysis of variance for characteristics of Onion

S.O.V	df	Total weight of bulb per m2	Large bulb weight in m^2	Medium bulb weight in m^2	Small bulb weight in m^2	Number of bulb in m^2	Number of bulb >6 Cm	Number of bulb between 4-6 cm	Number < of bulb 4 Cm
Replication	2	6662113.021 **	556428.688**	1018465.771 *	539663.063 *	191.313 ns	291.083 **	139 ns	1709.146*
Time	3	70428.188 ns	265391.056 ns	60107.194 ns	29095.41 ns	37.25 ns	15.167 ns	8.188 ns	75.91 ns
Error A	6	361089.521 ns	191169.91 ns	178867.715 ns	62464.951 ns	85.313 ns	13.917 ns	ns 48.667	ns 146.701
Concentration	3	732467.299 *	575450.389 ns	422196.139 **	30315.632 ns	73.361 ns	25.444 ns	90.188*	15.576 ns
Time × Concentration	9	246132.558 ns	190010.593 ns	821200.954 ns	30118.447 ns	48.824 ns	10.5	ns 13.706	44.984 ns
Total Error	24	221466118	222181.188	58878.47	62397.201	107.646	11.569	19.972	141.007
CV		19.61	58.72	24.96	39.93	22.6	57.49	28.95	48.43

**, ** significantly at the 1% and 5% levels of probability respectively and ns (non significant)*

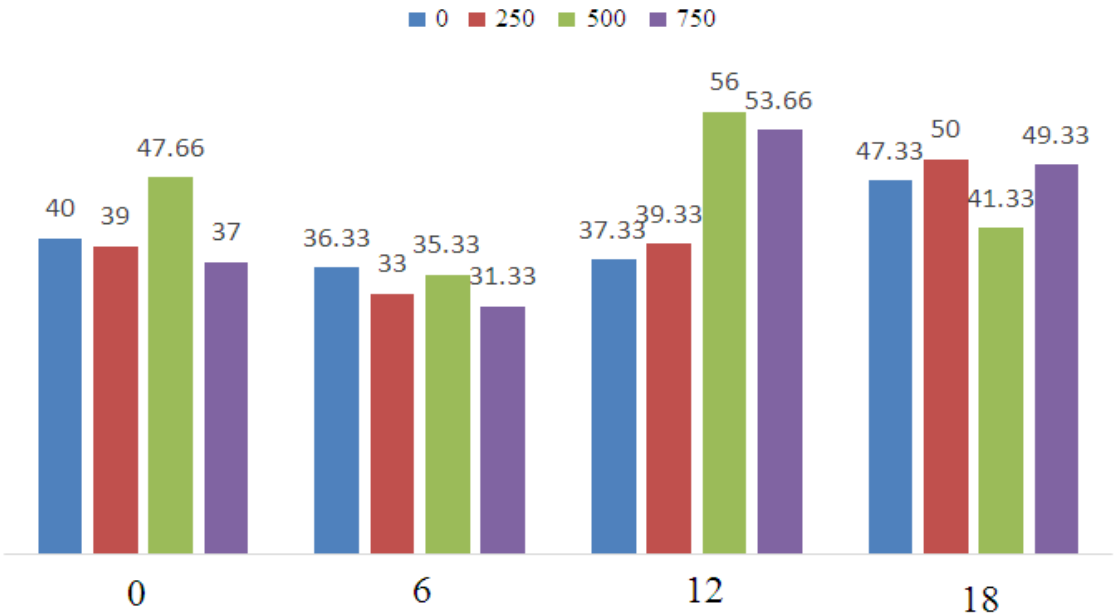

Figure 1: Interaction effect of time and hormone concentration on number of small bulb (<4cm)

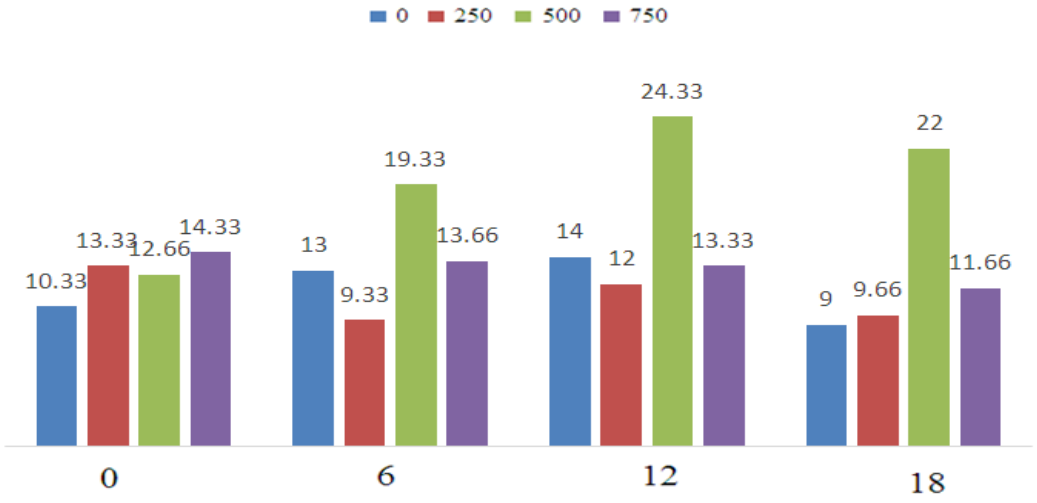

Figure 2: Interaction effect of time and hormone concentration on number of middle bulb (4-6 cm)

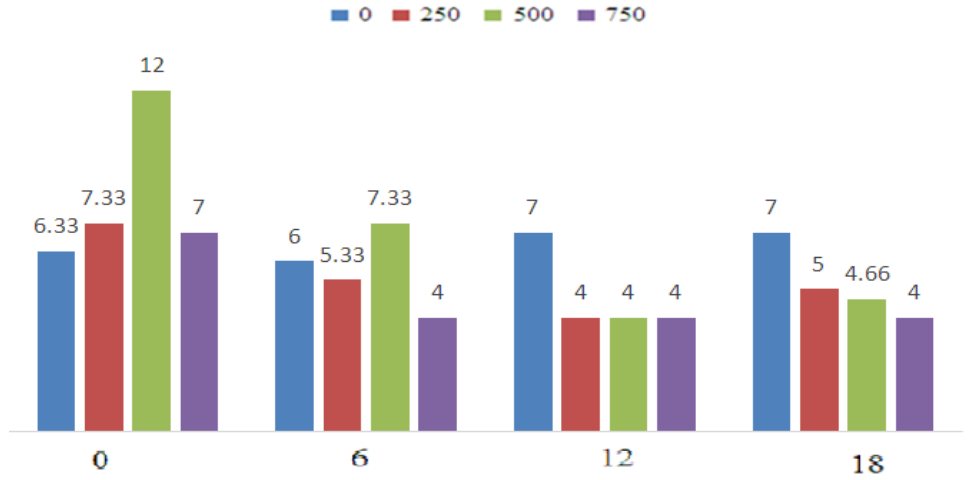

Figure 3: Interaction effect of time and hormone concentration on number of large bulb (>6 cm)

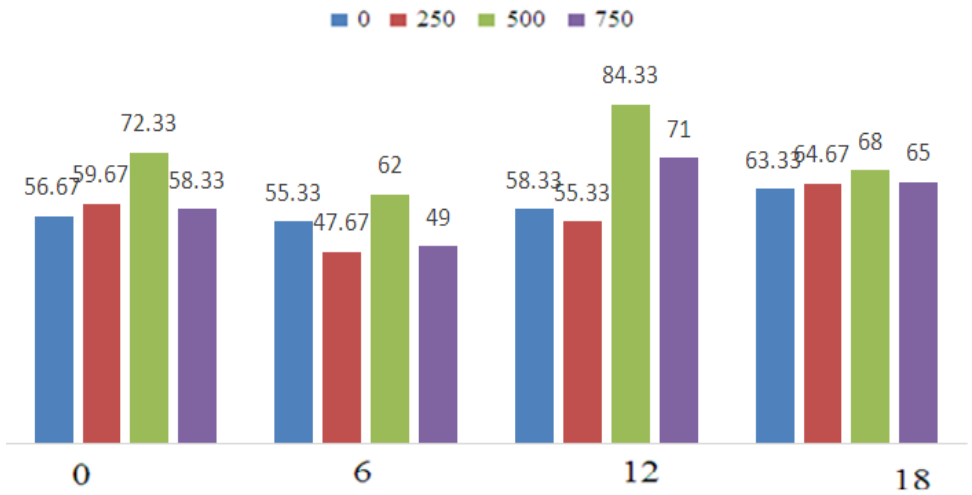

Figure 4: Interaction effect of time and hormone concentration on total number

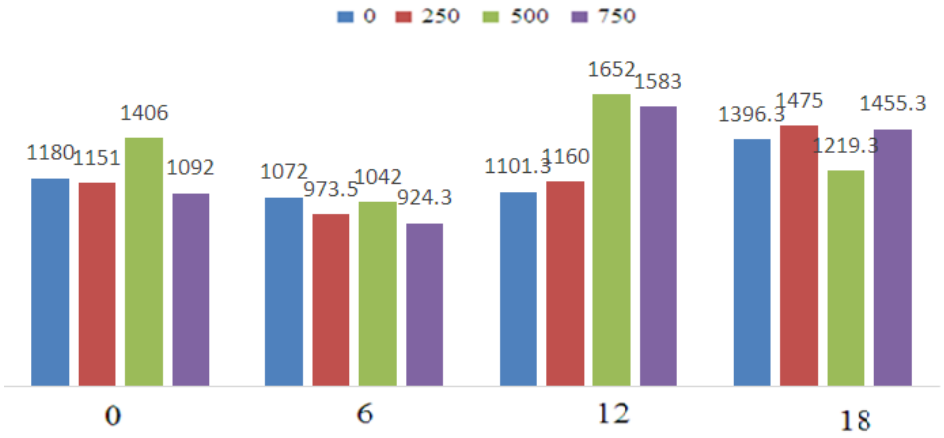

Figure 5: Interaction effect of time and hormone concentration on Weight of small bulb

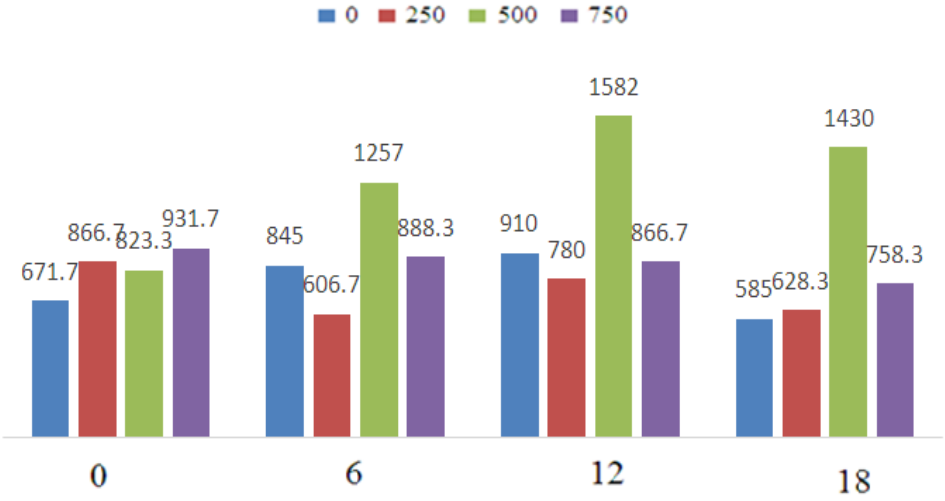

Figure 6: Interaction effect of time and hormone concentration on Weight of middle bulb

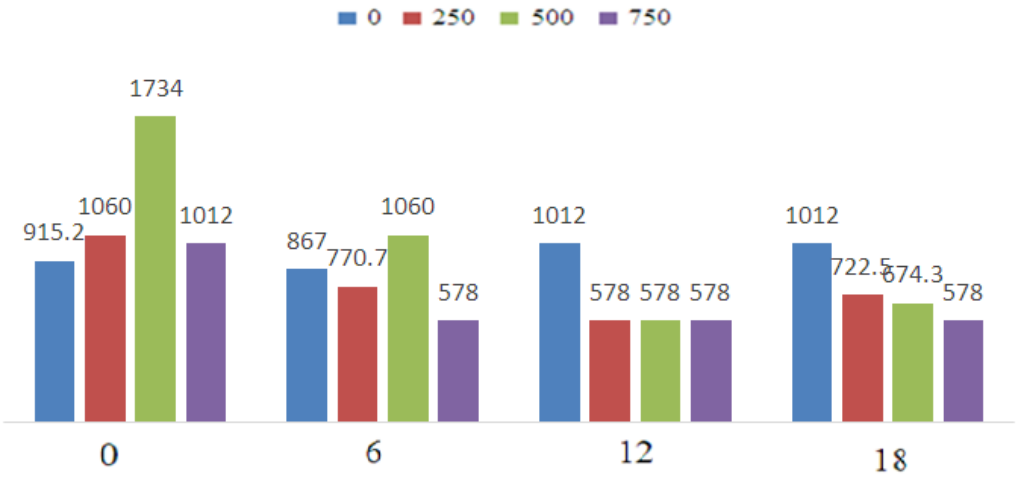

Figure 7: Interaction effect of time and hormone concentration on Weight of large bulb

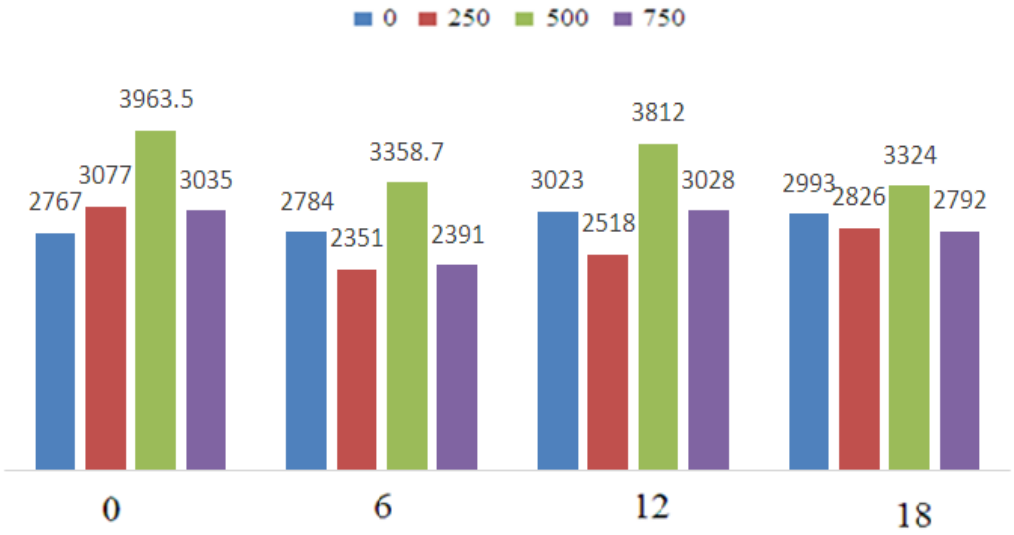

Figure 8: Interaction effect of time and hormone concentration on total weight

This difference was effective in yield. At the first rank, maximum number of cubes per square meter was observed at 12-hour time treatment and 500 milligrams per liter hormonal concentration. At the last rank, minimum number of cubes (9 per square meter) was observed at 18 hours and zero hormonal concentration. The statistical analysis considering the interactive effect of time and different hormonal concentrations on the number of those bulb whose diameters were larger than 6 cm showed a significant difference according to interactive effect table. At the first rank, the maximum number is observed at control time treatment and 500 milligrams per liter hormonal concentration (n=12) while the minimum number was observed at 6 hours and 750 milligrams per liter hormonal concentration and 12 hours and 250, 500 and 750 milligrams per liter hormonal concentrations at the last rank (n=4).

Statistical analysis on the interactive effect of time and hormonal concentrations on the number of bulb per unit area (square meters) showed a significant difference according to ANOVA Table. Therefore, maximum number of bulb was observed at 12 hours and 500 milligrams per liter hormonal concentration in the first rank while the minimum number was observed at 6 hours and 250 milligrams per liter hormonal concentration at the last rank. Statistical analysis on the interactive effect of time and hormonal concentrations on weights of those bulb whose diameters were smaller than 4 cm per unit area (square meters) was significant according to ANOVA Table. At the first rank, the maximum weight of 1652 grams per square meter was observed at 12 hours and 500 milligrams per liter hormonal concentration while the minimum weight of 924.3 gram per square was observed at 12 hours and 750 milligrams per liter hormonal concentration at the last rank. Statistical analysis on the interactive effect of time and various hormonal concentrations on weights of medium-sized bulb whose diameters were between 4 and 6 cm indicated a significant difference. At the first rank, maximum weight of 1582 grams per square meter was observed at 12 hours and 500 milligrams per liter hormonal concentration while the minimum weight of 585 grams per square meter was observed at 18 hours and zero hormonal concentration at the last rank. Statistical analysis on the interactive effect of time and various hormonal concentrations on the weight of large-sized bulb whose diameters were greater than 6 cm showed a significant difference. At the first rank, the highest yield of 1734 grams per square meter was observed at control time and 500 milligrams per liter hormonal concentration. The lowest yield of 578 grams per square meter was observed at 12 hours and 250, 500 and 750 milligrams per liter hormonal concentration and 6 hours and 18 hours with 750 milligrams per liter hormonal concentration. ANOVA results showed that the interactive effect of time and various hormonal concentrations on total weight of bulb was significant. At the first rank, the highest weight of 3963.5 grams per square meter (with respect to number of plots) was observed at control time and 500 milligrams per liter hormonal concentration. The lowest weight of 2351

grams per square meter (with respect to number of plots) was observed at 6 hours and 250 milligrams per liter hormonal concentration at the last rank.

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