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Influence of Gibberellic acid (GA_3), dry yeast and PK-fertilizer on flowering and seed yield of onion (*Allium cepa* L.)

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Abstract

The present experiment was conducted during the two successive seasons of 2019/2020 and 2020/2021 at the farm of Dammas district, Dakahlia Governorate, Egypt to investigate the effect of gibberellic acid (GA_3) concentrations, dry yeast, phosphorus and potassium foliar spraying on onion bulb cv. Giza 20 Mohassan for increasing seed yield of onion. The experimental was included g treatment with three replications as follows: Control (without any addition), 50 ppm GA_3, 100 ppm GA_3, 4 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O), 8 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O), 12 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O), 50 ppm GA3 + 4g/L (dry yeast + phosphoric acid, 16% P2O2 + potassium silicate, 32% K2O), 50 ppm GA3 + 8 (dry yeast + phosphoric acid, 16% P2O2 + potassium silicate, 32% K2O), 50 ppm GA3 + 12 (dry yeast + phosphoric acid, 16% P2O2 + potassium silicate, 32% K2O). A randomized complete block design (RCBD) with three replicates. Results revealed that 100 ppm GA_3, being the most effective on seed quality of onion, seed germination percentage (%). This result was followed by the treatment of 50 ppm GA_3 + 8/g/L (dry yeast + phosphoric acid + potassium silicate), with gradually increasing. Conclusively: it can be concluded that GA_3 at the concentration of 100 ppm and 50 ppm GA_3 with the triple foliar application treatment of dry yeast + phosphoric acid + potassium silicate at the rate of 8 g/L, being the most effective treatments on flowering, and quality of onion seed.

Keywords: GA_3, dry yeast, Pk fertilizer, flowering and seed quality, onion.

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1. Introduction

Onion (*Allium cepa* L.) is one of the most important spices, as well as vegetable crops in the world. Onion belongs to the family Alliaceae is one of the most widely cultivated vegetable and spice crops in the world. Many attempts were taken in the recent past to augment the seed yield and to improve the quality of onion seed and overcome the cytoplasmic male sterility [1]. The growth regulators are considered as key factors in vegetable growth, flowering, fruit setting and seed production in plant, but a few researchers carried out experiments involving growth regulators as influencing for in onion seed production and overcome male sterility. From most experiments were conducted in various parts of the world, it is revealed that GA_3 at various concentrations had remarkable effects on plant height, number of flowers per umbel, umbel diameter and seed production of onion [2]. Gibberellin is such an organic compound that has gibbane skeleton and that stimulate cell division or cell elongation or both. As well as, it plays key role in fruit setting and flowering [3]. The onion umbel contains perfect flowers with mature pollen and receptive stigma present at the sometime. Production of onion seed is based on systems of cytoplasmic and Genic male sterility [4]. Plants, need all nutrients in different ratios for their growth, development stages, flowering and seed production, Nutrients such as, phosphorus is an important nutrient and contribute to increase seed yield [5], as well as potassium plays an important role in increasing translocation of photosynthetic assimilates and water use efficiency [6]. In addition, potassium can improve the growth, yield and quality of plants [7]. Bio-stimulants are biologically active compounds that in hence metabolism and promote plant development when applied in small quantities. Bio-stimulants contain microelements, hormones, enzymes, proteins, vitamins, amino acids, and other compounds [8]. Dry yeast is a natural bio-substance suggested to be useful stimulatory, nutritional and protective functions. Many investigators and researchers pointed out that foliar spray

with dry yeast increased plant growth, seed yield and quality of some vegetable crops [9,10,11,12,13].

The objectives of the present investigations were to elucidate the effect of GA_3, dry yeast, phosphorus and potassium applications as foliar spray on onion bulb and increase flowering and seed quality of onion.

2. Materials and Methods

The present experiment was conducted during the two successive seasons of 2019/2020 and 2020/2021 at the farm of Dammas district, Dakahlia Governorate, Egypt to investigate the effect of gibberellic acid (GA_3) concentrations, dry yeast, phosphorus and potassium foliar spraying on onion bulb cv. Giza 20 Mohassan for increasing flowering and seed quality of onion. Physical and chemical analysis of the investigated soil were tabulated in Table (1) and irrigation water in Table (2). In this study, the onion bulbs were used as experimental materials. The weight of the bulbs required for each treatment was made uniform by weighing before planting. The onion bulbs were planted at 20 and 23 of October, 2019 and 2020 seasons, respectively. The experimental was included 9 treatments with three replications as follows:

1- Control (without any addition)
2- 50 ppm GA_3.
3- 100 ppm GA_3.
4- 4 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).
5- 8 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).
6- 12 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).
7- 50 ppm GA3 + 4 (dry yeast + phosphoric acid, 16% P2O2 + potassium silicate, 32% K2O).
8- 50 ppm GA3 + 8 (dry yeast + phosphoric acid, 16% P2O2 + potassium silicate, 32% K2O).
9- 50 ppm GA3 + 12 (dry yeast + phosphoric acid, 16% P2O2 + potassium silicate, 32% K2O).

A randomized complete block design (RCBD) with three replicates. The plot area was 7.2 m^2 (4 ridges of 3 m long and 0.6 m width), bulbs were planted on one side of ridge at 20 cm a part and medium bulbs of uniform size (6-7 g) were planted at a depth of 2.5 cm. Active dry yeast was dissolved in water followed by adding sugar at ratio 1: 1 and kept for 24 hours for activation and reproduction of yeast before application on the plants. Onion plants were sprayed with the yeast culture, phosphorus and potassium, as well as gibberellic acid three times during the growth period, the first was after one month from the bulbs emergence, the second was after two weeks of the first and the third was applied after two weeks of the second one. The other cultural procedures of growing onion were practiced as usually followed in the commercial production of seed onion yield.

2.1: Data recorded

2.1.1: Flowering trails

Five plants randomly chosen to determine the flowering at 4 months from planting and the data were recorded, i.e. height of flowering stalk (cm), number of flowering stalk per plant, number of flowers per umbel, number of seeded fruits per umbel, and umbel diameter (cm).

2.1.2: Seed quality

At harvest time, the N, P and K contents of seeds as a percentage were determined as the methods described by [14] and germination percentage.

2.2: Statistical analysis

The obtained data were statistically analyzed according to [15] at compare the mean of treatments by the least significant differences (LSD) at 5% probability and using SAS program [16].

3. Results and Discussion

3.1: Flowering trails

Data present in Tables (3 and 4) indicated the effect of GA_3, dry yeast, phosphoric acid and potassium silicate on flowering characters of onion seed production. It is conspicuous from the data that foliar application of onion plants with GA_3 at the concentration of 100 ppm significantly increased the flowering characters, i.e. flowering stalk height, number of flowering stalk/ plant, number of flowers/umbel, number of seeded fruit/ umbel, fruit set percentage, and umbel diameter, this result are true in both growing seasons. Gibberellic acid has considerable effects at high concentration (100 ppm) compared to the other treatments. Concerning the role of GA_3 on flowering characters, [17,3] demonstrated that GA_3 promotes the bio processes which increase the concentration of hormones to encourage and stimulate the stalk height and increased other characters of flowering. This result followed by the treatment of GA_3 at the concentrate of 50 ppm + 8 g/L (dry yeast + phosphoric acid + potassium silicate) and 50 ppm GA_3 + 4 g/L (dry yeast + phosphoric acid + potassium silicate), respectively. Regarding the important role of dry yeast, phosphorus and potassium in increasing the flowering characters of onion plants, [9] concluded that dry yeast is a natural bio-substance suggested to be useful stimulatory, nutritional and has many hormones which activated the flowering and enhanced most of flowering characters. Moreover, [7] stated that potassium is an essential plant macro-nutrient that plays an important role in many vital physiological processes to plant nutrient, water uptake and promote the flowering characters.

In addition, [18] confirmed that phosphorus plays an important role in cell division, fruit development and stimulates early root development and flowering, these results are in accordance with those obtained by [19,3] with GA_3, [20] with P- fertilizer and [21] with K- fertilizer.

3.2: Seed quality of onion

Data presented in Table (5) reveal in a similar result that 100 ppm GA_3, being the most effective on seed quality of onion, i.e. N, P, K, and seed germination percentage (%). This result is true in both growing seasons. This result was followed by the treatment of 50 ppm GA_3 + 8/g/L (dry yeast + phosphoric acid + potassium silicate), with gradually increasing. The obtained results are confirmed with those of [22,3,12,23] with GA_3, dry yeast, phosphorus and potassium as foliar application, respectively.

Table 1: Physical and chemical of analysis of soil used in the experiment study

Characters		Values
Physical analysis		
Coarse sand	(%)	3.37
Fine sand	(%)	15.97
Silt	(%)	33.86
Clay	(%)	46.80
Textural class		Clay loam
Chemical analysis:		
Organic matter (%)		1.4
Available N ppm		81.43
Available P ppm		19.17
Exchangeable k ppm		279.67
E.C. M mhos/cm at 25 °c		4.10
pH		7.4

Table 2: The analysis of irrigated water for irrigation the soil experiment

Analysis	Values
Total salts (ppm)	810.35
Ca^{++} (mg/L)	11.79
Mg^{++} (mg/L)	14.81
No^{++} (mg/L)	7.8
K^{+} (mg/L)	1.93
SO_4^{--} (mg/L)	4.11
$H\ CO_3^{-}$ (mg/L)	2.85
ECC Electric Conductivity) (dS/m)	0.61

Table 3: Effect of GA_3, dry yeast +PK-fertilizer and its combined effect on number of flowers and umbel diameter of onion during 2019/2020 and 2020/2021 seasons

Treatments	Number of flowers/umbel		Umbel diameter (cm)	
	2019/2020	2020/2021	2019/2020	2020/2021
Control (without any addition)	207.15	206.29	4.47	4.44
50 ppm GA3	225.77	226.23	7.07	7.03
100 ppm GA3	251.67	253.22	8.67	8.64
4 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	210.63	208.60	6.14	6.17
8 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	213.11	213.07	6.25	6.23
12 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	233.61	234.67	7.11	7.07
50 ppm GA3 + 4 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K2O).	235.39	235.44	7.19	7.23
50 ppm GA3 + 8 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	248.69	247.87	8.24	8.45
50 ppm GA3 + 12 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	217.55	216.39	6.28	6.31
LS.D (0.05)	2.43	2.45	0.07	0.06

Table 4: Effect of GA_3, dry yeast +PK-fertilizer and its combined effect on flowering of onion during 2019/2020 and 2020/2021 seasons

Treatments	Height of flowering stalk/plant (cm)		Number of flowering stalk/plant		Number of seeded fruits /umbel	
	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021
Control (without any addition)	55.45	56.21	3.16	3.19	150.89	149.77
50 ppm GA_3	61.49	61.55	3.55	3.51	171.87	172.55
100 ppm GA_3	66.91	66.87	3.93	3.90	187.59	187.36
4 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O)	55.89	54.33	3.22	3.25	163.58	164.07
8 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O)	58.57	58.43	3.33	3.37	164.85	165.29
12 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O)	60.27	61.13	3.36	3.41	169.77	170.13
50 ppm GA3 + 4 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	63.47	63.49	3.66	3.61	184.59	185.29
50 ppm GA3 + 8 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	65.87	64.39	3.79	3.83	185.79	186.33
50 ppm GA3 + 12 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	61.63	62.17	3.61	3.57	174.29	173.83
LS.D (0.05)	1.22	1.24	0.08	0.07	1.23	1.27

Table 5: Effect of GA_3, dry yeast +PK-fertilizer and its combined effect on seed quality of onion during 2019/2020 and 2020/2021 seasons

Treatments	N (%)		P (%)		K (%)		Germination percentage (%)	
	2019/20	2020/21	2019/20	2020/21	2019/20	2020/21	2019/20	2020/21
Control (without any addition)	0.61	0.58	0.11	0.12	0.63	0.61	74.17	74.21
50 ppm GA_3 .	0.69	0.66	0.15	0.14	0.74	0.72	78.21	79.23
100 ppm GA_3.	0.83	0.84	0.18	0.17	0.89	0.87	83.15	83.19
4 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	0.63	0.62	0.13	0.15	0.66	0.68	75.66	75.69
8 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	0.65	0.63	0.13	0.13	0.71	0.70	75.81	75.89
12 g/L (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	0.66	0.67	0.14	0.15	0.73	0.72	77.89	77.83
50 ppm GA3 + 4 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	0.77	0.75	0.16	0.15	0.84	0.81	79.36	79.32
50 ppm GA3 + 8 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	0.82	0.80	0.17	0.16	0.86	o.82	80.13	80.17
50 ppm GA3 + 12 g (dry yeast + phosphoric acid, 16% P_2O_2 + potassium silicate, 32% K_2O).	0.72	0.73	0.16	0.14	0.77	0.75.	79.31	79.25
LS.D (0.05)	0.01	0.01	0.01	0.01	0.02	0.01	0.04	0.04

4. Conclusions

It can be concluded that gibberellic acid (GA_3) at the concentration of 100 ppm and 50 ppm GA_3 with the triple foliar application treatment of dry yeast + phosphoric acid + potassium silicate at the rate of 8 g/L, being the most effective treatments on flowering and seed quality of onion.

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