Effect of gibberellic acidand zinc sulphate on growth, yield and quality of Cucumber (*Cucumis sativus*L.)

Abstract

An experiment entitled **Effect of gibberellic acidand zinc sulphate on growth, yield and quality of cucumber (*Cucumis sativus*L.)** was conducted at Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during February-May, 2023 on Cucumber. Experiment was laid out in factorial randomized block design with twenty treatment combinations and was replicated thrice. The experiment consisted of two factors. Factor H: Hybrids (TMCU-1107, TMCU-1125, TMCU-3112 and Saira-934) and Factor T: Different concentrations of GA□+ZnSO□ (T0 - Control (water spray), T_1 -GA□ 100ppm+ZnSO□ 0.25%, T_2 - GA□ 200ppm+ ZnSO□ 0.50%, T_3 - GA□ 300ppm+ ZnSO□ 0.75% and T_4 - GA□ 400ppm+ZnSO□ 1%).TMCU-1125 recorded significantly higher yield attributes of cucumber over other hybrids in parameters like vinelength at 80 DAS (102.6 cm), Days to 50% flowering (40), Days to 1st harvest (46), Number of fruits per plant (11), Fruit length (18.4 cm), Average fruit weight (237.5 g), Average fruit yield per plant (2.6 kg) and ascorbic acid content (0.8 mg/100g). Among different treatments, GA□ @300ppm+ ZnSO□ @0.75% resulted in significantly higher vinelength at 80 DAS (98.4 cm), Days to 50% flowering (43), Days to 1st harvest (50), Number of fruits per plant (9), Fruit length (16.6 cm), Average fruit weight (232.0 g), Average fruit yield per plant (2.0 kg) and ascorbic acid content (0.5 mg/100g). The intraction effect of T8(TMCU-1125 + GA□ @300ppm+ ZnSO□ @0.75% is best suited for getting higher growth, yield, quality of cucumber.

***Keywords**-gibberellic acid, zinc, growth, yield, and quality.*

1. Introduction

Vegetable are important nutritive components of the daily diet hecause their nutritive value as a vital source of micronutrient has been well recognized. Vegetables play an important role in the balance diet by providing not only energy but also supplying vital protective nutrients either mineral and vitamins. Thus, vegetables are getting increasingly higher importance in India as well as in the world due to their relevance in achieving nutritional security from emerging nutritional problems in human beings. Today, India is the second largest producer of vegetables in the world after China. According to recommendations given by Indian Council of Medical Research (ICMR) an average man with vegetarian or non-vegetarian food habit should consume (300 g) vegetables per day, which include 125g leafy vegetable, 100g root vegetable and 75g other vegetables, but its availability of vegetable in India is only 225g.

Plant growth regulators can enhance the uptate of utilization of micronutrients in plant. certain PGRs can improve root growth and development, leading to increased exploration of soil for micronutrients. Foliar spray of plant growth regulators also promote growth, increases yield and quality in plants and micronutrients can serve as supplementary sources of essential elements for plants.

Gibberellins commonly known as gibberellic acids first came to the attention of western scientists in 1950s, they had been discovered much earlier in Japan. Gibberellic acid (also called gibberellin A3, GA, and GA3) is a hormone found in plants and fungi. Gibberellins (GAs) play important role in the development of lateral roots (LRs), which are critical for plant productivity. Therefore, it is of great importance for cucumber production to study the role of GAs in LR development. Here, the results showed that GAs regulated cucumber LR development in a concentration-dependent manner.

Zinc sulphate is the inorganic compound with the formula ZnSO4. The addition of fertilizers to supplement natural soil fertility is a routine practice in modern agriculture, although temperate and tropical soils commonly remain deficient in micronutrients, particularly zinc (Zn) This work aimed to study the influence of foliar spray of zinc (as zinc sulphate) on growth parameters.

2. Materials and Methods

TheinvestigationwascarriedoutattheHorticultureResearchField,DepartmentofHorticulture,NainiAgriculturalInstitute,SamHigginbottomUniversityofAgriculture,Technology & Sciences, Prayagraj during Feb-May,2023.Theexperimentwasconducted in Factorial Randomized Block Designwith 20 treatments in three replications *viz.* TC_1: H_1T_0 - TMCU-1107+control(waterspray), TC_2: H_1T□ TMCU-1107+$GA_3$100ppm+ZnSO□0.25%,TC_3:H_1T□TMCU-1107+$GA_3$200ppm+ZnSO□0.5%,TC_4:H_1T□ TMCU-1107+$GA_3$300ppm+ZnSO□0.75%,TC_5: H_1T□ TMCU-1107+$GA_3$400ppm+ZnSO□1%, TC_6: H_2T□ TMCU-1125+control(waterspray),TC_7: H_2T□ TMCU-1125+$GA_3$100ppm+ZnSO□0.25%, TC_8: H_2T□ TMCU-1125+$GA_3$200ppm+ZnSO□0.5%, TC_9: H_2T□ TMCU-1125+$GA_3$300ppm+ZnSO□0.75%, TC_{10}: H_2T□ TMCU-1125+$GA_3$400ppm+ZnSO□1%, TC_{11}: H_3T_{10} - TMCU-3112+control(waterspray), TC_{12}: H_3T_1□ TMCU-3112+$GA_3$100ppm+ZnSO□0.25%,TC_{13}:H_3T_1□TMCU-3112+$GA_3$200ppm+ZnSO□0.5%,TC_{14}:H_1T_1□ TMCU-3112+$GA_3$300ppm+ZnSO□0.75%,TC_{15}: H_3T_1□ TMCU-3112+$GA_3$400ppm+ZnSO□1%, TC_{16}: H_4T_1□ Saira-934+control(waterspray),TC_{17}: H_4T_1□ Saira-934+$GA_3$100ppm+ZnSO□0.25%, TC_{18}: H_4T_1□ Saira-934+$GA_3$200ppm+ZnSO□0.5%, TC_{19}: H_4T_1□ Saira-934+$GA_3$300ppm+ZnSO□0.75%, TC_{20}: H_4T_1□ Saira-934 +$GA_3$400ppm+ZnSO□1%. with four

cucumber hybrids TMCU-1107, TMCU-1125, TMCU-3112 and Saira-934. Cropwas planted with the spacing of 150×50 cm withtheapplicationofFYM@18tonnes+NPK100:50:50 as basal dose along with spraying ofGA□+ZnSO□ which was done at 15 and 30 days after emergence of two true leaf stage. The data was recorded for thefollowingparameters*viz*Vinelength (cm),days to 50% flowering,days to first harvest, number of fruits per plant, avg. Number of picking, avg. fruit length (cm),averagefruitweight (g),fruit girth (cm), average yield per plant (kg), totalyield (t/ha),TSS(^{o}Brix)andascorbicacid content (mg/100g).TSSwasmeasured with the help of hand refractrometerandVitaminCwasmeasuredbynutrilizationmethod.

3. RESULTSANDDISCUSSION

The data on yield attributes of cucumber after application of gibberellic acid and zinc sulphate was recorded and is presented in Table1. Among different hybrids. Hybrid H2 (TMCU- 1125) recorded significantly longer vine at 80 DAS (102.6 cm), lesser number of days to 50% flowering (40), days to 1st harvest (46), number of fruits per plant (11), fruit length (18.4 cm), average fruit weight (237.5 g), average fruit yield per plant (2.6 kg) and ascorbic acid content (0.8 mg/100g) followed by vine at 80 DAS (101.3 cm), days to 50% flowering (41), days to 1st harvest (47), number of fruits per plant (10), fruit length (17.9 cm), average fruit weight (236.4 g), average fruit yield per plant (2.4 kg) and ascorbic acid content (0.7 mg/100g) in hybrid H1 (TMCU-1107) and shorter vine at 80 DAS (99.1 cm), more number of days to 50% flowering (42), late harvest (49), lower number of fruits per plant (9), lower fruit length (17.4 cm), average fruit weight (234.3 g), average fruit yield per plant (2.2 kg) and ascorbic acid content (0.6 mg/100g) in Hybrid H4 (Saira-934). Among different treatments, significantly longer vines at 80 DAS (107.1 cm), lesser number of days to 50% flowering (36), days to 1st harvest (42), number of fruits per plant (13), fruit length (19.9 cm), average fruit weight (244.2 g), average fruit yield per plant (3.2 kg) and ascorbic acid content (1.8 mg/100g) were recorded in (GA_3 @300 ppm + $ZnSO_4$ @0.75%). followed by vine at 80 DAS (104.9 cm), days to 50% flowering (40), days to 1st harvest (46), number of fruits per plant (12), fruit length (18.9 cm), average fruit weight (240.0 g), average fruit yield per plant (2.8 kg) and ascorbic acid content (0.8 mg/100g) in (GA3 @200 ppm + $ZnSO_4$ @0.50%). and shorter vine at 80 DAS (92.3 cm), more number of days to 50% flowering (46), late harvest (52), lower number of fruits per plant (6), lower fruit length (16.0 cm), average fruit weight (227.3 g), average fruit yield per plant (1.5 kg) and ascorbic acid content (0.4 mg/100g) in control (water spray).

Intraction data reaveled that treatment T8(TMCU-1125+ GA3 @300 ppm + @0.75%) recorded significantly longer vine at 80 DAS (107.8 cm), lesser number of days to 50% flowering (35), days to 1st harvest (41), number of fruits per plant (14), fruit length (20.9 cm), average fruit weight (245.7 g), average fruit yield per plant (3.4 kg) and ascorbic acid content (1.3 mg/100g) followed by in T3(TMCU-1107 + GA_3 @300ppm + $ZnSO_4$ @0.75%) vines at 80 DAS (107.6 cm), days to 50% flowering (36), days to 1st harvest (42), number of fruits per plant (13), fruit length (19.9 cm), average fruit weight (244.8 g), average fruit yield per plant (3.3 kg) and ascorbic acid content (1.0 mg/100g) in hybrid H1 (TMCU-1107) and shorter vine vine at 80 DAS (88.4 cm), more number of days to 50% flowering (48), late harvesting (54), lower number of fruits per plant (5), lower fruit length (15.2 cm), average fruit weight (225.5 g), average fruit yield per plant (1.2 kg) and ascorbic acid content (0.3 mg/100g) in Hybrid H4 (Saira-934).

Significanty longer vine was recorded with the application of (GA_3 @300 ppm + $ZnSO_4$ @0.75%). which might be due to combined effect of gibberellic acid and zinc sulphate. Gibberellic acid promotes stem

elongation, leaf expansion, and overall plant growth.It stimulates cell division and elongation, which can lead to increased plant height and leaf size. It also helps in overcoming growth inhibition under stress conditions, thus promoting better growth even in unfavorable environments.while, zinc is an essential micronutrient required for various metabolic processes in plants, including photosynthesis, enzyme activity, and hormone synthesis. It plays a crucial role in the synthesis of auxins, which are important for root development, flowering, and fruiting. The combination of gibberellic acid and zinc sulphate ensures that cucumber plants have optimal conditions for growth, development, and productivity. Thereby promoting better overall plant health, yield, and fruit quality of cucumber.

Table1.Effect of gibberellic acid and zinc sulphate of different cucumber hybrids ongrowth, yieldandqualityof cucumber

Hybrids → / Treatments ↓	Vinelength at 80 DAS					Days to50%flowering					Days to firstharvest					No. offruits/ plant				
	H1	H2	H3	H4	Mean T	H1	H2	H3	H4	Mean T	H1	H2	H3	H4	Mean T	H1	H2	H3	H4	Mean T
T0	93.4	96.9	90.6	88.4	92.3	45	44	46	48	46	52	51	53	54	52	7	7	6	5	6
T1	98.6	99.8	97.9	97.2	98.4	43	42	43	44	43	50	49	50	51	50	9	9	8	8	9
T2	105.4	105.6	104.9	103.6	104.9	40	39	40	41	40	46	44	46	47	46	12	12	12	11	12
T3	107.6	107.8	107.0	105.9	107.1	36	35	37	38	36	42	41	42	44	42	13	14	13	13	13
T4	101.7	102.7	100.6	100.3	101.3	41	41	42	42	41	48	47	48	49	48	10	11	10	10	10
Mean H	101.3	102.6	100.2	99.1		41	40	42	42		47	46	48	49		10	11	10	9	

Vinelength at 80 DAS			Days to50%flowering			Days to firstharvest			No. offruits/ plant		
Factors	**SE(d)±**	**$CD_{0.05}$**	**Factors**	**SE(d)±**	**$CD_{0.05}$**	**Factors**	**SE(d)±**	**$CD_{0.05}$**	**Factors**	**SE(d)±**	**$CD_{0.05}$**
Factor(H)	0.018	0.036	Factor(H)	0.043	0.088	Factor(H)	0.054	0.110	Factor(H)	0.018	0.036
Factor(T)	0.020	0.040	Factor(T)	0.048	0.098	Factor(T)	0.060	0.123	Factor(T)	0.020	0.040
Factor(HX T)	0.039	0.080	Factor(HX T)	0.097	0.197	Factor(HX T)	0.121	0.245	Factor(HX T)	0.039	0.080

Hybrids → / Treatments ↓	Fruit length (cm)					Averagefruit weight (g)					Averagefruit yield /plant (kg)					Ascorbicacid content(mg/100g)				
	H1	H2	H3	H4	Mean T	H1	H2	H3	H4	Mean T	H1	H2	H3	H4	Mean T	H1	H2	H3	H4	Mean T
T0	16.3	16.5	15.9	15.2	16.0	227.7	229.4	226.5	225.5	227.3	1.5	1.7	1.4	1.2	1.5	0.4	0.5	0.3	0.3	0.4
T1	16.5	16.9	16.4	16.7	16.6	232.4	233.4	231.7	230.6	232.0	2.1	2.1	1.9	1.8	2.0	0.5	0.5	0.4	0.4	0.5
T2	19.0	19.2	18.8	18.6	18.9	240.5	241.5	239.5	238.5	240.0	2.9	2.9	2.8	2.7	2.8	0.9	0.9	0.9	0.8	0.8
T3	19.9	20.9	19.6	19.3	19.9	244.8	245.7	243.7	242.5	244.2	3.3	3.4	3.1	3.1	3.2	1.0	1.3	0.9	0.9	1.8
T4	17.9	18.4	17.2	17.2	17.8	236.4	237.4	235.5	234.5	236.0	2.4	2.6	2.2	2.2	2.4	0.6	0.8	0.7	0.6	0.7
Mean H	17.9	18.4	17.6	17.4		236.4	237.5	235.4	234.3		2.4	2.6	2.2	2.2		0.7	0.8	0.6	0.6	

Fruit length (cm)			Averagefruit weight (g)			Averagefruit yield /plant (kg)			Ascorbicacid content(mg/100g)		
Factors	**SE(d)±**	**$CD_{0.05}$**	**Factors**	**SE(d)(±)**	**$CD_{0.05}$**	**Factors**	**SE(d)±**	**$CD_{0.05}$**	**Factors**	**SE(d)±**	**$CD_{0.05}$**
Factor(H)	0.012	0.024	Factor(H)	0.104	0.051	Factor(H)	0.004	0.009	Factor(H)	0.023	0.046
Factor(T)	0.013	0.026	Factor(T)	0.116	0.057	Factor(T)	0.005	0.010	Factor(T)	0.026	0.052
Factor(HX T)	0.026	0.053	Factor(HX T)	0.233	0.114	Factor(HX T)	0.010	0.019	Factor(HX T)	0.051	0.104

Note: H1- (TMCU-1107), H2-(TMCU-1125), H3- (TMCU- 3112) and H4 - (Saira- 934)

T-Differentconcentrations ofgibberellic acid and zinc sulphate

Conclusion

Based on the results of the present investigation entitled "Effect of gibberellic acid and zinc sulphate on growth, yield and quality of cucumber (Cucumis sativus L.)" it is concluded that among the different treatment combinations of hybrids, gibberellic acid and zinc sulphate, treatment T8 (TMCU - 1125 + GA3 @300 ppm + ZnSO4 @0.75%) recorded significantly better results in vine length, days to 50% flowering, days to 1st harvest, number of fruits per plant, fruit length, average fruit weight, average fruit yield per plant, and ascorbic acid content as well as significantly higher Benefit Cost Ratio of 3.41.

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