



P-ISSN: 2349-8528

E-ISSN: 2321-4902

[www.chemijournal.com](http://www.chemijournal.com)

IJCS 2021; 9(1): 1541-1544

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Received: 07-11-2020

Accepted: 18-12-2020

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## Influence of bulb treatment with Bio-fertilizers and foliar spray of Bio-stimulants on growth and flowering of tuberose (*Polianthes tuberosa* L.) cv. Suvasini

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**DOI:** <https://doi.org/10.22271/chemi.2021.v9.i1v.11443>

**Abstract**

This study was conducted to assess the Influence of Bulb treatment with Bio-Fertilizers and foliar spray of Bio-Stimulants on growth and flowering of Tuberose (*Polianthes tuberosa* L.) cv. Suvasini. The experiment was laid out in Contrast Factorial Randomised Blocked Design consisting of two factors with three and eight levels respectively. Replicated thrice at SKLTSHU, college of horticulture, Mojerla. Tuberose bulbs were treated with three Bio-Fertilizers viz., phosphate solubilizing bacteria (PSB), Azospirillum (AZO) and Potassium solubilizing bacteria (KSB) each 200 g/l and they are foliar sprayed by eight Bio-Stimulants gibberellic acid (GA<sub>3</sub>), salicylic acid (SA), cycocel (CCC) and humic acid (HA) each at 200 ppm and 400 ppm. Among bio fertilizers PSB (Phosphate solubilizing bacteria) and among bio stimulants GA<sub>3</sub> 400 ppm. while in interaction effect PSB (Phosphate solubilizing bacteria) 200 g/l along with GA<sub>3</sub> (Gibberellic acid) 400 ppm has resulted significantly best in Plant height (cm), Number of leaves per plant, Length of leaf (cm), Days taken to spike emergence, Spike length (cm), Diameter of spike (cm), Rachis length (cm), Number of florets per spike, Number of spikes per plant, Flower longevity (days), Flower yield or spike yield per hectare (in lakhs), when compared with other treatment combinations and control.

**Keywords:** Tuberose, bulb treatment, PSB, AZO, KSB

**Introduction**

Tuberose (*Polianthes tuberosa* L.) is one of the important bulbous flowering crop. From Mexico, it Spreaded out to the different parts of the world during 16th century (Tiwari and Singh, 2002) [1]. Tuberose is commonly known as 'Rajanigandha' and 'Nelampengi' in India. Tuberose is commercially grown due to its potential for cut flower, loose flower, long vase life of spikes and pleasant fragrance. (Singh and Kumar, 1999) [2]. The flowers remain fresh for quite a long time and withstand distance transportation and occupy a prime place in the flower market (Patel, 2006) [3].

In contrast, to inorganic fertilizer the use of bio-fertilizers and bio-stimulants has been increasing. Bio-fertilizers are biologically active product containing selective strains of microorganism which can contribute nutrients to the plants through microbial activity. These are supplements of chemical fertilizers as they contribute to plant nutrition through biological nitrogen fixation and solubilization of immobile phosphorous (Kumar *et al.*, 2002) [4]. Bio-stimulants are products of natural and organic origin that stimulate plants to achieve their highest growth and yield potential. Bio-stimulants are akin to Bio-fertilizers as they also promote crop growth and yield. The use of Bio-stimulants along with bio-fertilizers could reduce chemical fertilizer use to a large extent and as much as 50% as they supplement the soil with essential nutrients.

**Material and Methods**

The bulbs of tuberose were treated with bio-fertilizers (Phosphate solubilizing bacteria, Azospirillum and Potassium solubilizing bacteria) each 200 g/l. bulb's were sown on ridge and furrow system with 30 x 20 cm spacing between rows and plant respectively.

After germination they were foliar sprayed by bio-stimulants (GA<sub>3</sub>, Salicylic acid, Cycocel, Humic acid each at 200 ppm and 400 ppm) There were replicated 3 times for each treatment and experiment was laid out in contrast factorial randomized Block design.

From the treatment plot five plants were selected and observations are recorded on growth and flowering parameters. Plant height (cm) (30, 60 and 90 days interval), Number of leaves / plants (30, 60 and 90 days interval), Length of leaf (cm) (30, 60 and 90 days interval). Flower parameters such as Days taken to spike emergence, Spike length (cm), Diameter of spike (cm), Rachis length (cm), Number of florets per spike, Number of spikes / plants, Flower longevity (days), Flower yield or spike yield / hectare (in lakhs).

## Results and Discussion

### Growth parameters

(Table-1,2,3) In growth parameters the bio-fertilizer Phosphate solubilizing bacteria (PSB) @ 200 g/l was recorded significantly best results in growth parameters where control showing significant difference with the treatments. PSB 200 g/l (Phosphate solubilizing bacteria) recorded highest Plant height at 30, 60 and 90 days with 11.84 cm, 32.15 cm and 44.81 cm respectively. Also recorded highest number of leaves / plants recorded at 30, 60 and 90 days with 5.56, 10.73 and 18.58 respectively. PSB recorded highest length of leaf at 30, 60 and 90 days with 9.62 cm, 18.84 cm and 28.10 cm respectively. When compared with other bio-fertilizers and control treatment. (Table-1,2,3) The bio-stimulants GA<sub>3</sub> 400 ppm was recorded significantly best results in growth parameters. where control showing significant difference with the treatments. GA<sub>3</sub> 400 ppm recorded highest Plant height at 30, 60 and 90 days with 13.23 cm, 33.71 cm and 46.52 cm respectively. Also recorded highest number of leaves / plants recorded at 30, 60 and 90 days with 5.92, 11.95 and 20.28 respectively. GA<sub>3</sub> 400 ppm recorded highest length of leaf at 30, 60 and 90 days with 10.43 cm, 19.69 cm and 28.30 cm respectively. When compared with other bio-stimulants and control treatment. (Table-1,2,3) Coming to the interaction effect of bio-fertilizers and bio-stimulants where the combination of PSB 200 g/l (Phosphate solubilizing bacteria) + GA<sub>3</sub> 400 ppm was recorded significantly best results in growth parameters. where control showing significant difference with the treatments. PSB 200 g/l (Phosphate solubilizing bacteria) + GA<sub>3</sub> 400 ppm recorded highest Plant

height at 30, 60 and 90 days with 16.08 cm, 38.00 cm and 50.13 cm respectively. Also recorded highest number of leaves / plants recorded at 30, 60 and 90 days with 7.08, 13.50 and 22.99 respectively. PSB 200 g/l (Phosphate solubilizing bacteria) + GA<sub>3</sub> 400 ppm recorded highest length of leaf at 30, 60 and 90 days with 11.95 cm, 21.68 cm and 30.95 cm respectively. When compared with other treatment combinations and control treatment.

### Floral parameters

(Table-4,5,6) In floral parameters the bio-fertilizer Phosphate solubilizing bacteria (PSB) @ 200 g/l was recorded significantly best results in floral parameters. Where control showing significant difference with the treatment. where it has taken lowest number of days for first spike emergence (153.16 days), highest Spike length (65.39 cm), maximum diameter of spike (0.81 cm), maximum Rachis length (19.46 cm), highest number of florets per spike (29.08), highest number of spikes / plants (1.93), maximum flower longevity (18.88 days), highest flower yield or spike yield / hectare (0.15 in lakhs). When compared with other bio-fertilizers and control treatment.

(Table-4,5,6) The bio-stimulant GA<sub>3</sub> 400 ppm was recorded significantly best results in floral parameters. Where control showing significant difference with the treatment. where it has taken lowest number of days for first spike emergence (149.72 days), highest Spike length (66.04 cm), maximum diameter of spike (0.85 cm), maximum Rachis length (20.89 cm), highest number of florets per spike (31.08), highest number of spikes / plants (2.23), maximum flower longevity (20.24 days), highest flower yield or spike yield / hectare (0.17 in lakhs). When compared with other bio-stimulants and control treatment.

(Table-4,5,6) Coming to the interaction effect of bio-fertilizers and bio-stimulants where the combination of PSB 200 g/l (Phosphate solubilizing bacteria) + GA<sub>3</sub> 400 ppm was recorded significantly best results in floral parameters. where control showing significant difference with the treatments. where it has taken lowest number of days for first spike emergence (136.24 days), highest Spike length (70.53 cm), maximum diameter of spike (0.94 cm), maximum Rachis length (24.28 cm), highest number of florets per spike (35.62), highest number of spikes / plants (2.59), maximum flower longevity (21.91 days), highest flower yield or spike yield / hectare (0.24 in lakhs). When compared with other treatment combinations and control treatment.

**Table 1:** Influence of Bulb treatment with Bio-fertilizers and foliar spray of Bio-stimulants on plant height at 30, 60 and 90 days in tuberose cv. Suvasini

Bio stimulants (Factor - 2)	Bio fertilizers (Factor - 1)											
	30 days				60 days				90 days			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean
S <sub>1</sub> - GA <sub>3</sub> 200 ppm	15.73	10.68	11.46	12.62	35.28	30.28	34.72	33.43	48.80	42.13	48.60	46.51
S <sub>2</sub> - GA <sub>3</sub> 400 ppm	16.08	9.41	14.20	13.23	38.00	27.87	35.27	33.71	50.13	44.97	44.47	46.52
S <sub>3</sub> - SA 200 ppm	9.81	9.63	10.46	9.97	29.52	33.67	27.56	30.25	41.87	42.23	41.50	41.87
S <sub>4</sub> - SA 400 ppm	10.48	10.44	11.26	10.73	34.34	27.33	30.23	30.63	42.90	41.87	42.67	42.48
S <sub>5</sub> - CCC 200 ppm	12.78	9.57	9.92	10.76	30.74	28.02	28.08	28.95	47.07	41.80	42.70	43.86
S <sub>6</sub> - CCC 400 ppm	9.54	11.32	9.39	10.08	29.14	30.22	25.61	28.32	42.30	44.63	40.13	42.35
S <sub>7</sub> - HA 200 ppm	10.06	10.19	10.4	10.22	32.06	29.3	28.3	29.89	43.20	42.33	41.97	42.50
S <sub>8</sub> - HA 400 ppm	10.27	9.81	11.00	10.36	28.09	33.16	26.69	29.31	42.20	43.40	42.53	42.71
mean	11.84	10.13	11.01		32.15	29.98	29.56		44.81	42.92	43.07	
control	8.11				25.40				40.57			
	P	S	P × S	control	P	S	P × S	control	P	S	P × S	control
S.Em±	0.03	0.09	0.26	0.46	0.07	0.18	0.53	1.94	0.09	0.24	0.73	1.29
LSD@5%	0.09*	0.25*	0.75*	0.93*	0.19*	0.50*	1.51*	1.89*	0.26*	0.69*	2.07*	2.58*

GA<sub>3</sub> = Gibberellic acid, SA = Salicylic acid, CCC = Cycocel, HA = Humic acid, (P<sub>1</sub>) PSB = Phosphate solubilizing bacteria, (P<sub>2</sub>) AZO = Azospirillum, (P<sub>3</sub>) KSB = Potassium solubilizing Bacteria

**Table 2:** Influence of Bulb treatment with Bio-fertilizers and foliar spray of Bio-stimulants on number of leaves per plant at 30, 60 and 90 days in tuberose cv. Suvasini

Bio stimulants (Factor - 2)	Bio fertilizers (Factor - 1)											
	30 days				60 days				90 days			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean
S <sub>1</sub> - GA <sub>3</sub> 200 ppm	6.90	4.14	6.50	5.85	12.90	8.68	12.34	11.31	21.11	18.99	15.88	18.66
S <sub>2</sub> - GA <sub>3</sub> 400 ppm	7.08	3.95	6.73	5.92	13.50	10.15	12.20	11.95	22.99	20.94	16.90	20.28
S <sub>3</sub> - SA 200 ppm	5.86	4.12	5.53	5.17	10.74	8.71	11.40	10.28	19.01	20.17	16.36	18.51
S <sub>4</sub> - SA 400 ppm	4.12	5.79	4.35	4.75	9.19	11.39	8.38	9.65	16.38	16.76	18.87	17.34
S <sub>5</sub> - CCC 200 ppm	6.08	3.84	6.83	5.58	10.19	8.68	9.87	9.58	19.25	19.99	16.18	18.47
S <sub>6</sub> - CCC 400 ppm	4.87	4.05	4.11	4.34	9.14	8.94	8.36	8.81	16.81	15.11	15.98	15.97
S <sub>7</sub> - HA 200 ppm	4.94	4.71	4.79	4.81	10.07	10.54	8.56	9.72	16.33	16.36	16.90	16.53
S <sub>8</sub> - HA 400 ppm	4.62	5.75	3.98	4.78	10.07	10.47	8.75	9.76	16.78	15.96	18.31	17.02
mean	5.56	4.54	5.35		10.73	9.70	9.98		18.58	18.04	16.92	
control	4.13				8.06				15.04			
	P	S	P × S	control	P	S	P × S	control	P	S	P × S	control
S.Em±	0.02	0.06	0.17	0.30	0.02	0.06	0.18	0.31	0.04	0.10	0.30	0.53
LSD@5%	0.06*	0.16*	0.49*	0.61*	0.06*	0.17*	0.50*	0.62*	0.11*	0.28*	0.85*	1.06*

GA<sub>3</sub> = Gibberellic acid, SA = Salicylic acid, CCC = Cycocel, HA = Humic acid, (P<sub>1</sub>) PSB = Phosphate solubilizing bacteria, (P<sub>2</sub>) AZO = Azospirillum, (P<sub>3</sub>) KSB = Potassium solubilizing Bacteria

**Table 3:** Influence of Bulb treatment with Bio-fertilizers and foliar spray of Bio-stimulants on length of leaves (cm) at 30, 60 and 90 days in tuberose cv. Suvasini

Bio stimulants (Factor - 2)	Bio fertilizers (Factor - 1)											
	30 days				60 days				90 days			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean
S <sub>1</sub> - GA <sub>3</sub> 200 ppm	11.46	7.78	9.32	9.52	20.45	16.04	18.80	18.43	29.90	25.33	29.15	28.13
S <sub>2</sub> - GA <sub>3</sub> 400 ppm	11.95	8.56	10.77	10.43	21.68	17.40	19.99	19.69	30.95	26.35	27.59	28.30
S <sub>3</sub> - SA 200 ppm	9.85	8.15	9.81	9.27	18.74	16.30	19.67	18.24	27.46	25.29	27.30	26.68
S <sub>4</sub> - SA 400 ppm	8.29	9.80	8.26	8.78	17.73	19.43	16.00	17.72	29.17	24.91	25.50	26.53
S <sub>5</sub> - CCC 200 ppm	10.48	7.91	9.13	9.17	16.05	20.28	16.60	17.64	26.48	27.17	23.92	25.86
S <sub>6</sub> - CCC 400 ppm	8.27	9.33	7.71	8.44	17.64	19.15	15.30	17.36	25.74	27.72	26.03	26.50
S <sub>7</sub> - HA 200 ppm	8.06	9.54	8.14	8.58	20.43	15.44	19.03	18.30	27.17	28.80	25.79	27.25
S <sub>8</sub> - HA 400 ppm	8.6	10.06	8.18	8.95	17.99	19.38	16.18	17.85	27.96	29.49	25.73	27.73
mean	9.62	8.89	8.92		18.84	17.93	17.70		28.10	26.88	26.38	
control	7.93				14.82				24.51			
	P	S	P × S	control	P	S	P × S	control	P	S	P × S	control
S.Em±	0.02	0.06	0.17	0.29	0.04	0.10	0.30	0.53	0.06	0.15	0.45	0.80
LSD@5%	0.06*	0.16*	0.47*	0.59*	0.11*	0.29*	0.86*	1.07*	0.16*	0.43*	1.28*	1.60*

GA<sub>3</sub> = Gibberellic acid, SA = Salicylic acid, CCC = Cycocel, HA = Humic acid, (P<sub>1</sub>) PSB = Phosphate solubilizing bacteria, (P<sub>2</sub>) AZO = Azospirillum, (P<sub>3</sub>) KSB = Potassium solubilizing Bacteria

**Table 4:** Influence of Bulb treatment with Bio-fertilizers and Foliar spray of Bio-stimulants on spike emergence (days), spike length (cm), diameter of spike (cm) in tuberose cv. Suvasini

Bio stimulants (Factor - 2)	Bio fertilizers (Factor - 1)											
	spike emergence (days)				spike length (cm)				diameter of spike (cm)			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean
S <sub>1</sub> - GA <sub>3</sub> 200 ppm	143.37	161.64	145.28	150.10	69.10	59	66.73	64.94	0.90	0.72	0.89	0.84
S <sub>2</sub> - GA <sub>3</sub> 400 ppm	136.24	163.33	149.58	149.72	70.53	59	68.60	66.04	0.94	0.86	0.74	0.85
S <sub>3</sub> - SA 200 ppm	156.00	161.55	163.90	160.48	65.23	58.4	68.17	63.93	0.74	0.71	0.72	0.72
S <sub>4</sub> - SA 400 ppm	161.24	151.61	159.39	157.41	64.90	59.8	58.37	61.02	0.81	0.74	0.88	0.81
S <sub>5</sub> - CCC 200 ppm	157.68	158.58	165.23	160.50	62.63	58.47	58.63	59.91	0.76	0.75	0.71	0.74
S <sub>6</sub> - CCC 400 ppm	157.39	164.45	161.70	161.18	63.5	60.13	57.37	60.33	0.87	0.71	0.79	0.79
S <sub>7</sub> - HA 200 ppm	158.30	164.41	146.68	156.46	65.53	68.83	58.37	64.24	0.70	0.71	0.69	0.70
S <sub>8</sub> - HA 400 ppm	155.05	154.43	163.67	157.72	61.7	68.60	58.03	62.78	0.74	0.84	0.74	0.77
mean	153.16	160.00	156.93		65.39	61.53	61.78		0.81	0.76	0.77	
control	163.97				59.23				0.65			
	P	S	P × S	control	P	S	P × S	control	P	S	P × S	control
S.Em±	0.32	0.87	2.60	NS	0.11	0.28	0.84	1.49	0.002	0.004	0.013	0.02
LSD@5%	0.92*	2.46*	7.38*	NS	0.30*	0.80*	2.40*	3.00*	0.005*	0.012*	0.037*	0.05*

GA<sub>3</sub> = Gibberellic acid, SA = Salicylic acid, CCC = Cycocel, HA = Humic acid, (P<sub>1</sub>) PSB = Phosphate solubilizing bacteria, (P<sub>2</sub>) AZO = Azospirillum, (P<sub>3</sub>) KSB = Potassium solubilizing Bacteria

**Table 5:** Influence of Bulb treatment with Bio-fertilizers and foliar spray of Bio-stimulants on rachis length (cm), number of florets per spike, number of spikes per plant in tuberose cv. Suvasini

Bio stimulants (Factor - 2)	Bio fertilizers (Factor - 1)											
	rachis length (cm)				number of florets per spike				number of spikes per plant			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean
S <sub>1</sub> - GA <sub>3</sub> 200 ppm	23.55	16.11	21.09	20.25	34.32	24.45	30.09	29.62	2.14	2.09	1.95	2.06
S <sub>2</sub> - GA <sub>3</sub> 400 ppm	24.28	16.24	22.15	20.89	35.62	24.79	32.83	31.08	2.59	2.02	2.07	2.23
S <sub>3</sub> - SA 200 ppm	17.58	19.41	14.8	17.26	23.11	33.74	20.16	25.67	1.34	1.76	2.04	1.71
S <sub>4</sub> - SA 400 ppm	16.49	20.69	15.01	17.40	34.29	32.14	20.79	29.07	1.92	1.94	1.87	1.91
S <sub>5</sub> - CCC 200 ppm	19.66	14.89	22.70	19.08	26.94	23.42	22.93	24.43	1.74	1.24	1.61	1.53
S <sub>6</sub> - CCC 400 ppm	21.94	14.56	23.14	19.88	22.99	29.67	20.39	24.35	1.92	1.74	1.34	1.67
S <sub>7</sub> - HA 200 ppm	16.16	19.65	14.28	16.70	29.64	25.38	31.64	28.89	1.78	1.42	1.93	1.71
S <sub>8</sub> - HA 400 ppm	15.98	22.55	14.43	17.65	25.73	32.28	23.16	27.06	1.98	1.76	1.86	1.87
mean	19.46	18.01	18.45		29.08	28.23	25.25		1.93	1.75	1.83	
control	12.58				21.52				1.97			
	P	S	P × S	control	P	S	P × S	control	P	S	P × S	control
S.Em±	0.04	0.10	0.31	0.55	0.10	0.27	0.81	1.43	0.01	0.03	0.10	NS
LSD@5%	0.11*	0.29*	0.88*	1.11*	0.29*	0.77*	2.30*	2.88*	0.03*	0.09*	0.27*	NS*

GA<sub>3</sub> = Gibberellic acid, SA = Salicylic acid, CCC = Cycocel, HA = Humic acid, (P<sub>1</sub>) PSB = Phosphate solubilizing bacteria, (P<sub>2</sub>) AZO = Azospirillum, (P<sub>3</sub>) KSB = Potassium solubilizing Bacteria

**Table 6:** Influence of Bulb treatment with Bio-fertilizers and Foliar spray of Bio-stimulants on number of spikes per plant, flower longevity (days), Flower yield per hectare (in lakhs) in tuberose cv. Suvasini

Bio stimulants (Factor - 2)	Bio fertilizers (Factor - 1)											
	number of spikes per plant				flower longevity (days)				Flower yield per hectare (in lakhs)			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	mean
S <sub>1</sub> - GA <sub>3</sub> 200 ppm	2.14	2.09	1.95	2.06	21.19	15.47	19.36	18.67	0.21	0.11	0.11	0.14
S <sub>2</sub> - GA <sub>3</sub> 400 ppm	2.59	2.02	2.07	2.23	21.91	19.82	18.99	20.24	0.24	0.16	0.1	0.17
S <sub>3</sub> - SA 200 ppm	1.34	1.76	2.04	1.71	20.00	15.23	13.83	16.35	0.09	0.11	0.15	0.12
S <sub>4</sub> - SA 400 ppm	1.92	1.94	1.87	1.91	17.18	13.85	20.64	17.22	0.12	0.08	0.17	0.12
S <sub>5</sub> - CCC 200 ppm	1.74	1.24	1.61	1.53	19.13	14.75	21.10	18.33	0.11	0.06	0.08	0.08
S <sub>6</sub> - CCC 400 ppm	1.92	1.74	1.34	1.67	20.11	15.34	14.83	16.76	0.11	0.08	0.08	0.09
S <sub>7</sub> - HA 200 ppm	1.78	1.42	1.93	1.71	14.44	19.06	13.53	15.68	0.13	0.09	0.18	0.13
S <sub>8</sub> - HA 400 ppm	1.98	1.76	1.86	1.87	17.08	19.73	12.81	16.54	0.16	0.11	0.13	0.13
mean	1.93	1.75	1.83		18.88	16.66	16.89		0.15	0.10	0.13	
control	1.97				12.22				0.08			
	P	S	P × S	control	P	S	P × S	control	P	S	P × S	control
S.Em±	0.01	0.03	0.10	NS	0.04	0.10	0.30	0.53	0.001	0.003	0.009	0.02
LSD@5%	0.03*	0.09*	0.27*	NS*	0.11*	0.29*	0.86*	1.07*	0.003*	0.009*	0.026*	0.03*

GA<sub>3</sub> = Gibberellic acid, SA = Salicylic acid, CCC = Cycocel, HA = Humic acid, (P<sub>1</sub>) PSB = Phosphate solubilizing bacteria, (P<sub>2</sub>) AZO = Azospirillum, (P<sub>3</sub>) KSB = Potassium solubilizing Bacteria

## Conclusion

From the results, it can be concluded that among the bio-fertilizers Phosphate solubilizing bacteria (PSB) 200g/l, in bio-stimulants GA<sub>3</sub> 400 ppm while in interaction effect of bio-fertilizers and bio-stimulants where the combination of PSB 200 g/l (Phosphate solubilizing bacteria) + GA<sub>3</sub> 400 ppm has significantly resulted best in Growth parameters such as, Plant height (cm) (30, 60 and 90 days interval), Number of leaves / plants (30, 60 and 90 days interval), Length of leaf (cm) (30, 60 and 90 days interval) and Floral parameters such as Days taken to spike emergence, Spike length (cm), Diameter of spike (cm), Rachis length (cm), Number of florets per spike, Number of spikes / plants, Flower longevity (days), Flower yield or spike yield / hectare (in lakhs).

## References

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