Effect of Gibberellic acid and Cytokinin on growth ,quality and yield of French bean (*Phaseolus vulgaris* L.) cv. Ellora NO. 11

ABSTRACT

A trial was conducted at the Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2022. This study investigates the "Effect of GA3 and Cytokinin on growth, quality and yield and of French bean (*Phaseolus vulgaris L.*) cv. Ellora No 11." The purpose of the study is to evaluate the plants in terms of various parameters such as day to germination , plant height, no.of branches, no. of leaves, days to first flowering, first picking days to 50% flowering , number of pod per plant, pod weight, fruit yield per plant, yield per hectare, total soluble solids (°BRIX), protein(%), fiber(%), ascorbic acid(mg), and benefit-cost ratio. The results of the study indicate that the application of increased percentage of GA3 and Cytokinin significantly improved the growth and yield tomatoes. The highest fruit yield, fruit weight, TSS, and ascorbic acid content were observed in the plants treated with T1 GA3@200ppm. The benefit- cost ratio was also found to be higher in the treated plants compared to the control. Overall, the study suggests that the application of GA3@200ppm and cytokinin@500ppm can be an effective and sustainable method for enhancing the growth, yield, and quality of French bean.

1.INTRODUCTION

French bean (***Phaseolus vulgaris*** *L.*) is most important and one of the widely grown vegetable leguminous vegetable crops of North eastern region. It is cultivated for the tender vegetable, shelled green beans and dry beans (rajma). It is very rich in protein, vitamins and minerals. Immature pods supply protein, carbohydrate, fat, fibre, thiamin, riboflavin. Ca and Fe. Seed contains significant amount of thiamine, niacin, folic acid and fibre.French bean is popular as a dietary food, because it contain a lots of vitamins. French bean is a short duration crop and farmers get more profit in a short period. In this region, it is cultivated in rice fallow during spring summer and on hill slopes during autumn winter season. It has possibility to be grown round the year in this region where irrigation facilities are available during dry period. French beans are the immature green pods grown for local consumption and export. Due to high labour requirements, it is recommended that it be grown on a small scale, possibly with staggered planting. It is grown for both fresh consumption and processing. The green immature pods are cooked and eaten as a vegetable. Immature pods are marketed fresh, frozen or canned, whole, cut or French cut. It is also an important pulse crop,with high yielding ability as compared to gram and pea. It is grown in Maharahstra, Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and NE states. This is also known as kidney bean, snap bean, navy bean, haricot bean and common bean originated in the central and South America. It is extensively grown commercially and also in the home garden. In our country it is known as Farash bean. The role of growth regulator in crop production plant growth regulator are developed at very low concentration but inhibits plant growth and development at high concentration. More over, response of plant PGR may vary in different environmental conditions, physiological and nutritional status stages of development and endogenous hormonal balance. The use of plant growth regulator such as GA3,Cytokinin,auxin on their synthetic compound is becoming popular to ensure the efficient production .It has been reported that application of PGR enhance plant growth and crop yield PGR modified growth and development in various ways under normal and stress environmental conditions .Gibberellins are plant growth regulators that facilitate cell elongation and help the plants to grow taller .They also help in germination ,stem elongation , flowering and fruit ripening. Cytokinin promote cell division and increase cell expansion

2. MATERIAL AND METHOD

The present investigation entitle "Effect of Gibberellic acid and cytokinin on growth ,quality and yield of french bean (*Phaseolus vulgaris* L.) cv. Ellora No 11 carried out during the winter season of the 2023. The experiment was conducted in the Central Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P) during 2022 – 2023. All the facilities necessary for cultivation, including labour were made available in the department.The experiment was laid out in randomized block design (R.B.D.) with 3 replications of French bean. French bean was planted in the field at a spacing of 60cm × 15cm in plot of 1.8 m × 1.55 m size. Normal cultural practices and plant protection measures were followed during the cultivation process. Plants were selected at random from each plot of each treatments as representative sample for recording the data. Data was recorded on all the important character pertaining to the present study the cultural practice such as irrigation , weeding and plant protection measure were carried out uniformly as when they required.

Table 1 Number of treatment

Notaion	Name of treatment
T0	Control
T1	Gibberalin @200ppm
T2	Gibberalin @400ppm
T3	Gibberalin @600ppm
T4	Gibberalin @800ppm
T4	Gibberalin @1000ppm
T5	Cytokinin@250ppm
T6	Cytokinin@500ppm
T7	Cytokinin@750ppm
T8	Cytokinin@1000ppm

Results &discussion :

4.1 yield parameter

4.1.1 Effect of GA3 and cytokinin day to germination

Effect of GA3 and cytokinin day to germination showed the significant result as effected by various treatment .the minimum germination recorded in T1 GA3200ppm(7.37) followed by T7,T5,T3,T9 where as maximum germination recorded in T0 control (11.00) in table2. Cytokinin stimulates leaf expansion, the development of reproductive organ and delay senesce. The results are in agreement of finding of reported by Ammanullh*et al* (2000)

4.1.2. Effect of GA3 and Cytokinin on Plant height

Effect of GA3 and cytokinin plant height showed the significant result as effected by various treatment,the maximum plant height recorded in T1GA3 @200ppm (52.07) followed byT7Cytokinin@500ppm(50.67),T6(50.13),T9(50.13) where as minimum plant height recorded in T0 control(45.73) in table 2 extension of pant axis by the application of GA3 resulted in elongation of internodes of Phaseolus vulgaris the result are in agreement of finding of Greulach and Haesloop*et al*(1958).

4.1.3 Effect of GA3 and Cytokinin on number of Branches

Effect of GA3 and cytokinin number of branches showed the significant result as effected by various treatment. The maximum number of branches recorded in T1GA3 @200ppm(13.57) followed by T7 Cytokinin@500ppm (12.47), T3GA3@600ppm(12.53),T6Cytokinin@250ppm(12.47), T9 Cytokinin @1000ppm(12.57) where as minimum recorded in T0 Control(10.00) in table 2 the foliar application of pgr with different concentration led to significant increases in vegetative growth plant height. of leaf per plant , fresh and dry weight .The results are agreement of finding of Amin *et al*(2007).

Effe4.1.4 Effect of GA3 and Cytokinin on Number of leaves

Effect of GA3 and cytokinin number of leaves showed the significant result as effected by various treatment. The maximum number of branches recorded inT1GA3 @200ppm214.93)followedbyCytokinin500ppm(187.13),T3GA3@600ppm(183.00),T4GA3@800ppm188 .07),T6(186.80) where as minimum no. of leaves recorded in T0(177.87) in table 2 foliar application of pgr with different concentration led to significant increases in vegetative growth, plant height no. of leaf per plant , fresh and dry weight .the results are agreement of finding of Amin *et al*(2007).

4.2 yield parameter

4.2.1 Days to 1stflowering on treatment of GA3 and cytokinin

Effect of GA3 and cytokinin day to first flowering showed the significant result as effected by various treatment. The minimum day to first flowering recorded in T1 GA3 @200ppm(42.33) followed by cytokinin @500ppm(45.33),T5(45.33),T8(46.00),T3(46.3) where as maximum data recoreded in T0 control(52.00) in table 4 exogenous application of GA3 to arbidopsis induced flowering and effected plant morphology the result are in agreement of finding of Richards *et al* (1986)

4.2.2 Effect of GA3 and Cytokinin on Day of 1st pickling

Effect of GA3 and cytokinin day to first flowering showed the significant result as effected by various treatment. The minimum day to first flowering recorded in T1 GA3 @200ppm(42.33) followed by cytokinin @500ppm(53.67),T5(55.67),T8(54.00),T9(54.3) where as maximum data recoreded in T0 control(64.33) in table 4 exogenous application of GA3 induced flowering and effected plant morphology. The results are in agreement of finding of Richards *et al* (1986).

4.2.3 Effect of GA3 and Cytokinin on Day of 50% flowering

Effect of GA3 and cytokinin on day to first picking showed the significant result as effected by various treatment. The minimum day to first flowering recorded in T1 GA3 @200ppm(63.33) followedbycytokinin@500ppm(65.37),T5(65.4),T6(66.20),T4(65.37) where as maximum data recoreded in T0 control(76.33) in table 4 Gibberellic acid promotes growth in plants from seed germination to senescence. Further, gibberellic acid increases stem elongation, number of flowers per plant and induces fruit setting the result. Azuma*etal*.(1997).

4.2.4 Effect of GA3 and Cytokinin on Av. Pod length (cm)

Effect of GA3 and cytokinin pod length showed the significant result as effected by various treatment. The maximum pod length recorded in in T1 GA3 @200ppm(16.50) followed by cytokinin@500ppm(16.33),T4(16.20),T3(16.00) where as maximum data recoreded in T0 control(15.37) in table 4The treated plants exhibited higher pod length than the control plants. The hormone cytokinin had greater effect of pods length than the gibberellic acid treated plant .The results are in agreement of finding of Ammanullah*et al*(2000).

4.2.5 Effect of GA3 and Cytokinin on Av pod girth (cm)

Effect of GA3 and cytokinin pod girth showed the significant result as effected by various treatment. The maximum pod girth recorded in T1GA3@200ppm(2.67) followed by cytokinin @500ppm (2.37),T4(2.37),T3(2.33) where as maximum data recoreded in T0 control(2.13) in table 4it must be possible to increase berry size by means of GA3 application the result are in agreement of finding ofCoombe(1960).Afroz*etal*.,(2009)

4.2.6 Effect of GA3 and Cytokinin on Av. Pod weight (gm)

Effect of GA3 and cytokinin pod weight showed the significant result as effected by various treatment. The maximum pod weight recorded in T1 GA3 @200ppm(5.70) followed by cytokinin@500ppm(16.33),T4(55.07),T3(16.00) where as maximum data recoreded in T0 control(15.37) in table 4The treated plants exhibited higher pod length than the control plants. The hormone cytokinin had greater effect of pods length than the gibberellic acid treated plants. The result are in agreement of finding of Ammanullah*et al*.(2000).

4.2.6 Effect of GA3 and Cytokinin on. Pod weight per plant

Effect of GA3 and cytokinin pod per plant showed the significant result as effected by various treatment. The maximum pod per plant recorded in in T1 GA3 @200ppm(21.67) followed by cytokinin @500ppm (19.90),T8(19.13),T2(18.53),T9(17.63) where as maximum data recoreded in T0 control(15.23) in table

4Application of plant growth regulators at the vegetative and flowering stage increased plant biomass and fruiting. This further provided source for allocation of resources for the formation of pods. The results are in agreement of finding of Yang *et al* (2003).

4.2.7 Effect of GA3 and cytokinin yield per hac

Effect of GA3 and cytokinin yield per hac showed the significant result as effected by various treatment. The minimum day to first flowering recorded in T1 GA3 @200ppm(12.35) followedby,cytokinin@500ppm(10.80),T5(45.33),T8(46.00),T3(46.33) where as maximum data recoreded in T0 control(52.00) in table 4 exogenous application of GA3 to arbidopsis induced flowering and effected plant morphology. The results are in agreement of finding of Richards *et al* (1986).

4.3 quality parameter

4.3 .1 Effect of GA3 and cytokinin on TSS

Effect of GA3 and cytokinin TSS showed the significant result as effected by various treatment. The TSS recorded in in T1 GA3@200ppm(6.37) followed by cytokinin @500ppm(5.73),T3(5.63),T5(5.57),T4(5.53)where as maximum data recoreded in T0 control(5.13) in table 5concentration might be due to quick metabolic transformation of starch and pectin into soluble compound and rapid translocation of sugar from leaves to fruit Kameshwari *et al*[10]

4.3.2 Effect of GA3 and cytokinin on Vitamine C

Effect of GA3 and cytokinin vitamine C showed the significant result as effected by various treatment. The maximum vitamine C recorded in in T1 GA3 @200ppm(11.77) followed by cytokinin@500ppm(11.60),T8(11.57),T6(11.57), T2(11.57) where as maximum data recoreded in T0 control(11.13) in table 5concentration might be due to quick metabolic transformation of starch and pectin into soluble compound and rapid translocation of sugar from leaves to fruit Kameshwari *et al*[10]

4.3.3Effect of GA3 and cytokinin on Protein

Effect of GA3 and cytokinin Protein showed the significant result as effected by various treatment. The maximum Protein recorded in in T1 GA3@200ppm(1.52) followed by cytokinin @500ppm (1.50),T5(1.49),T6(1.49), T8(1.48) where as maximum data recoreded in T0 control(1.45) in table 5 Yeast is considered as a natural source of cytokinins that stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll were reported by Gobarah*et al*.(2006). Amer (2004)

4.3.4 Effect of GA3 and cytokinin fiber

Effect of GA3 and cytokinin fiber showed the significant result as effected by various treatment. The maximum **fiber** recorded in in T1 GA3@200ppm**(11.60)** followed by **T7** cytokinin @500ppm (**11.43)**where as maximum data recoreded in T0 control(**11.13**) in table 5 Yeast is considered as a natural source of cytokinine that stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll were reported by Gobarah*et al*.(2006). Amer (2004).

Table2. Benefit cost ratio (B:C)

Name of treatment	Yield (Tone/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	Benefit cost ratio
Control	8.04	321600	120000	201600	1.6
GA3@200	**12.35**	494000	120000	374000	**3.1**
GA3@400	10.24	409600	120000	289600	2.4
GA3@600	9.35	374000	120000	254000	2.1
GA3@800	8.48	339200	120000	219200	1.8
GA3@1000	8.34	333600	120000	213600	1.7
Cytokinin@250	8.60	344000	120000	224000	1.8
Cytokinin@500	**10.80**	432000	120000	312000	2.6
Cytokinin@750	9.69	387600	120000	267600	2.2
Cytokinin@1000	9.32	372800	120000	252800	2.1

Table 3. Mean performance of French bean on growth parameter

Notation	Name of treatment	Day to germination	Plant height (80D.A.S)	No. of branches (80 D.A.S)	No. of Leaves (80 D.A.S)
T0	**Control (water spray)**	11.00	45.73	10.00	177.87
T1	**GA3@200ppm**	**7.37**	**52.07**	**14.47**	**214.93**
T2	**GA3@400ppm**	9.87	49.33	12.20	170.07
T3	**GA3@600ppm**	9.30	49.07	12.53	183.00
T4	**GA3@800ppm**	9.70	49.73	11.57	188.07
T5	**GA3@1000ppm**	8.33	47.73	11.17	182.67
T6	**Cytokinin@250ppm**	10.00	50.13	12.47	186.80
T7	**Cytokinin@500ppm**	8.33	50.67	13.57	187.13
T8	**Cytokinin@750ppm**	9.00	49.60	11.53	182.33
T9	**Cytokinin@1000ppm**	8.33	50.13	12.57	153.73
	F Test	S	S	S	S
	SE(d)±	0.15	1.10	0.23	3.64
	CD(5%)	0.32	2.31	0.48	7.65
	CV	2.02	2.72	2.27	2.44

Table 4. Mean performance of French bean on yield parameter

Notation	Name of treatment	Day of 1st flowering (D.A.S)	Day of 50% flowering (D.A.S)	First picking (D.A.S)	Pod per plant	Pod length (cm)	Pod Girth (cm)	Pod weight per plant	Pod weight per pod(g)	pod per plant	Yield/ha (Tone)
T0	**Control (waterspray)**	52.00	64.33	76.33	15.23	15.37	2.13	52.80	5.28	15.23	8.04
T1	**GA3@200ppm**	42.33	53.67	63.33	15.93	16.50	2.63	57.63	5.70	21.67	12.35
T2	**GA3@400ppm**	46.67	57.00	67.50	15.43	15.87	2.33	55.33	5.53	18.53	10.24
T3	**GA3@600ppm**	46.67	56.67	66.77	21.67	16.00	2.37	54.00	5.40	17.33	9.35
T4	**GA3@800ppm**	48.00	56.33	65.37	18.53	16.20	2.37	55.07	5.50	15.43	8.48
T5	**GA3@1000ppm**	45.33	55.67	65.43	17.33	15.83	2.20	52.40	5.24	15.93	8.34
T6	**Cytokinin@250ppm**	47.33	55.67	66.20	16.33	16.33	2.17	52.77	5.27	16.33	8.60
T7	**Cytokinin@500ppm**	45.33	53.67	65.37	19.90	15.80	2.37	54.30	5.43	19.90	10.80
T8	**Cytokinin@750ppm**	46.00	53.00	66.90	19.13	15.70	2.20	50.73	5.07	19.13	9.69
T9	**Cytokinin@1000ppm**	46.33	54.33	69.20	17.63	15.63	2.13	52.97	5.29	17.63	9.32
	F Test	S	S	S	S	S	S	S	S	S	S
	SE(d)±	0.53	1.10	1.30	0.32	0.22	0.05	1.58	0.32	0.32	0.09
	CD(5%)	1.12	2.32	2.74	0.68	0.46	0.10	4.54	0.68	0.68	0.18
	CV	1.40	2.41	2.37	2.25	1.70	2.51	3.59	2.25	2.25	1.79

Table 5. Mean performance of French bean on Quality parameter

Notation	Name of treatment	TSS(°Brix)	Protein (%)	Fiber (%)	Vit C (mg)
T0	**Control (waterspray)**	5.13	1.45	3.82	11.13
T1	**GA3@200ppm**	**6.37**	**1.52**	**3.89**	**11.77**
T2	**GA3@400ppm**	5.30	1.46	3.86	11.57
T3	**GA3@600ppm**	5.73	1.48	3.86	11.43
T4	**GA3@800ppm**	5.53	1.47	3.84	11.43
T5	**GA3@1000ppm**	5.57	1.49	3.85	11.37
T6	**Cytokinin@250ppm**	5.47	1.49	3.85	11.57
T7	**Cytokinin@500ppm**	5.63	1.50	3.88	11.60
T8	**Cytokinin@750ppm**	5.13	1.45	3.82	11.13
T9	**Cytokinin@1000ppm**	6.37	1.52	3.89	11.77

CONCLUSION

From the above experiment finding. It may be conclude that the treatment ,T1 **(GA3@200ppm)** was found to be best in term of growth, yield and quality. Highest return and benefit-cost ratio was found in the same treatment T1 **GA3@200ppm (3.1).**

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