The Andhra Agric. J 59(1): 102-105, 2012

Effect of Plant Growth Regulators on Growth,Yield and Quality of French Bean

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ABSTRACT

A field experiment was conducted to study the effect of plant growth regulators on growth, flowering, yield and quality of french bean cv. Arka Komal at Students Farm, College of Agriculture, Rajendranagar, during *rabi* 2009-2010. All the concentrations of the plant growth regulators were sprayed at 20 and 40 days after sowing. The results revealed that foliar application of GA_3 250 ppm increased number of branches, number of leaves, intermodal length, and leaf area index number of pods per plant, pod length, pod weight and yield . Foliar spray of Cycocel 350 ppm increased the pod diameter. GA_3 250 ppm recorded minimum fiber content and maximum ascorbic acid content. Maximum protein content was recorded by NAA 20 ppm.

Key words : Cycocel,French bean, Gibberlic acid, Naphthalene Acetic Acid.

French bean (*Phaseolus vulgaris* L.) is one of the important leguminous vegetables grown in India. French bean is an important nutritive legume. Inspite of high yield potential, the actual yield of french bean is low because of many physiological reasons like reduced photosynthesis, bud abscission, bloom drop (Kay, 1979). The use of plant growth promoters promote growth along the longitudinal axis, increase number of leaves, leaf area and subsequently contributes towards higher production and productivity. Plant growth retarding substances not only decreases plant height but also facilitates branching, early flowering and yield. The present investigation was therefore, undertaken to determine the effect of plant growth regulators on growth, yield and quality of french bean cv. Arka Komal.

MATERIAL AND METHODS

The experiment was conducted at Students Farm, College of Agriculture, Rajendranagar during October to January, 2009-2010 in a Randomized Block Design with three replications. The French bean variety selected for the study was Arka Komal. The experiment was comprised of 10 treatments including water spray as control. The treatments were GA_3 (150 ppm, 200 ppm and 250 ppm), NAA (10 ppm, 15 ppm and 20 ppm), Cycocel (250 ppm, 300 ppm and 350 ppm) and water spray as control. All the concentrations of the plant growth regulators were sprayed at 20 and 40 days after sowing. The seeds were sown at a depth of 5 cm and spaced 50 cm between the rows and 30 cm within the row. The observations on growth, yield and yield attributes were recorded from 5 randomly selected plants out of 60 plants in each plot at monthly. The data was statistically analyzed as per the method described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Foliar spray of GA_3 250 ppm increased the plant height to 55.66 cm compared to its lower concentrations as well as NAA, Cycocel and control (water spray) (Table 1). This increase in plant height could be explained to its effect in enhancing cell division and cell elongation in growing portion of plants (Pandita *et al*., 1980). Minimum plant height (26.66 cm) was recorded in Cycocel 350 ppm. The reason for reduction in plant height might be due to its effect in reducing cell expansion and synthesis of diffusible endogenous growth substances (Cathey, 1964). These results are in conformity with the results reported by Kokare *et al.* (2006) in okra, Rajendra Prasad and Srihari (2008) in okra, Sharma and Lashkari (2009) in cluster bean.

Maximum number of branches per plant (15.08) were recorded with foliar spray of GA_3 250 ppm which was on par with GA_3 200 ppm (14.00) (Table 1). It might be due to rapid cell division and cell elongation in growing portion of plants and increased uptake of nutrients which resulted in maximum plant height and leading to the production of more number of branches. Minimum number of branches were recorded in Cycocel 250 ppm (9.50).

Table 1. Effect of plant growth regulators on growth of french bean cv. Arka Komal at maturity.

Treatments	Plant height (cm)	Number of leaves per plant	Number of branches per plant	Leaf area Index
GA_3 150 ppm		28.00	13.00	0.701
GA_3 200 ppm	40.66	33.00	14.00	0.738
GA_3 250 ppm	53.16	34.00	15.08	0.790
NAA 10 ppm	55.66	24.90	10.00	0.604
NAA 15 ppm	28.50	27.70	10.54	0.616
NAA 20 ppm	33.00	34.40	12.68	0.690
CCC 250 ppm	33.25	25.30	9.50	0.520
CCC 300 ppm	31.00	29.90	11.62	0.500
CCC 350 ppm	30.00	31.50	11.75	0.564
Control (water spray)	26.66	26.40	9.99	0.410
SE(m)	31.75	1.08	0.68	0.003
CD (P=0.05)	1.50	3.25	2.03	0.010
	4.56			

Table 2. Effect of plant growth regulators on yield of french bean cv. Arka Komal.

Treatments	Number of pods/plant	Pod length (cm)	Pod diameter (cm)	Weight of 10 pods (g)	Yield per plant (g)	Yield per plot (kg)	Yield per ha (q)
GA_3 150 ppm	12.31	11.20	0.98	48.83	59.77	3.13	33.44
GA_3 200 ppm	12.23	11.43	1.02	49.56	61.41	3.25	35.54
GA_3 250 ppm	12.53	11.68	1.06	52.33	67.21	3.52	40.44
NAA 10 ppm	10.72	10.26	0.96	43.06	45.90	2.52	31.96
NAA 15 ppm	11.91	10.53	0.98	46.20	54.74	2.94	32.18
NAA 20 ppm	12.01	10.85	1.04	47.16	57.46	3.06	34.44
CCC 250 ppm	10.51	10.30	0.98	35.26	37.50	2.20	28.18
CCC 300 ppm	11.46	9.60	1.04	36.23	41.96	2.30	30.10
CCC 350 ppm	11.91	9.41	1.07	42.00	49.10	2.76	33.29
Control (water spray)	10.02	10.37	1.02	37.33	37.18	2.05	28.10
SE(m)	0.08	0.14	0.015	1.65	0.50	0.07	1.79
CD (P=0.05)	0.26	0.43	0.046	4.95	1.52	0.22	5.37

The highest number of leaves per plant (34.40) were recorded in NAA 20 ppm where as minimum number of leaves per plant were recorded in NAA 10 ppm (24.90) (Table 1). The increase in number of leaves by the application of NAA due to it delay senescence through its effect on the mobilization of metabolites to the leaves. This may be the reason of maintenance of higher number of leaves upto the maturity of the plant. These results are in conformity with the results reported in fenugreek, Kokare *et al.* (2006) in okra, Sharma and Lashkari (2009) in clusterbean.

Foliar spray of GA_3 250 ppm recorded maximum leaf area index (0.790) where as minimum leaf area index (0.410) was recorded with control (Table 1). These results are in conformity with the results obtained by Nawalagatti *et al.* (2008) in french bean.

The maximum number of pods per plant (12.53) was obtained with GA_3 250 ppm. This was

Table 3. Effect of plant growth regulators on quality of french bean cv. Arka Komal.

Treatments	Fiber content (g)	Protein content (%)	Ascorbic acid content (mg $100g^{-1}$)
GA_3 150 ppm	3.23	2.11	11.20
GA_3 200 ppm	3.22	2.91	11.60
GA_3 250 ppm	3.18	2.97	12.40
NAA 10 ppm	3.31	2.55	10.80
NAA 15 ppm	3.28	2.89	11.20
NAA 20 ppm	3.26	3.02	11.20
CCC 250 ppm	3.57	2.84	10.00
CCC 300 ppm	3.58	2.32	10.00
CCC 350 ppm	3.74	2.78	10.80
Control (water spray)	3.56	2.01	10.80
SE(m)	0.01	0.05	0.24
CD (P=0.05)	0.04	0.16	0.73

on par with GA_3 150 ppm (12.31) (Table 2). This might be due to increased number of branches and fruiting points, which lead to better utilization of sunlight and the plants remained physiologically more active to build up sufficient food material for developing more number of pods per plant. Among the treatments studied control had recorded minimum number of pods per plant (10.02).

Maximum pod length (11.68 cm) was recorded with GA_3 250 ppm. This was on par with GA_3 200 ppm (11.43 cm) (Table 2). This may be due to rapid cell division and increased elongation of individual cell. These results are in conformity with Pandey *et al.* (2004) in garden pea, Rai *et al.* (2004) in french bean, Panchbhai *et al*. (2005) in spine gourd. Foliar spray of Cycocel 350 ppm recorded minimum pod length (9.41 cm).

Maximum pod diameter (1.07 cm) was recorded with Cycocel 350 ppm where as minimum pod diameter (0.96 cm) was recorded with NAA 10 ppm (Table 2). The increase in pod diameter by the application of Cycocel might be due to retard cell elongation. These findings are in conformity with Kokare *et al*. (2006) in okra.

Among the different plant growth regulators GA_3 250 ppm recorded maximum weight of 10 pods (52.33 g) (Table 2). This might be due to increased size of photosynthetic apparatus in terms of leaf area and leaf area index which increased assimilation rate contributing for better pod weight. Minimum weight of 10 pods (35.26 g) was recorded by Cycocel 250 ppm.

Application of GA_3 250 ppm recorded significantly increased yield $plant^{-1}$ (67.21 g $plant^{-1}$), yield $plot^{-1}$ (3.52 kg $plot^{-1}$) and yield ha^{-1} (40.44 q ha^{-1}) compared to its lower concentrations, other plant growth regulators and control (Table 2). This significant improvement in yield might be due to increased net photosynthetic rate by increasing number of branches, increasing number of leaves and leaf area index which might have resulted in increased number of pods, pod length and pod diameter resulted in increased pod yield per plant, per plot and per ha. Similar results were reported by Medhi (2000) in french bean, Pandey *et al*. (2004) in garden pea, Nawalagatti *et al.* (2008) in french bean. Whereas control (water spray) had recorded minimum yield $plant^{-1}$ (37.18 g/plant), yield $plot^{-1}$ (2.05 kg $plot^{-1}$) and yield/ha (28.10 q ha^{-1}).

Among the different plant growth regulators GA_3 250 ppm recorded minimum fiber content (3.18 g) which was on par with GA_3 200 ppm (3.22 g). Maximum fiber content (3.74 g) was recorded in Cycocel 350 ppm (Table 3). The decrease in fiber content by the application of GA_3 and NAA might be due to the growth promoters increased xylem thickness and increased the number of tracheary elements while the growth retardants decreased the xylem thickness and induced fiber formation (Martins *et al.,* 1998). These results are in conformity with the findings of Martins *et al.* (1998) in tomato, Mishriky (1990) in celery.

Maximum protein content (3.02 g) was recorded with foliar spray of NAA 20 ppm Whereas

minimum protein content (2.01 g) was observed in control (Table 3). Increase in protein content by the application of plant growth regulators might be due to increased uptake of nutrient particularly of nitrogen from the soil and its further assimilation led to the synthesis of protein. Bioregulators are known to promote the metabolism of assimilates or food materials by enhancing the various enzymatic activities leading to the production or conversion into mobile amino acids (Akazawa and Miyata, 1982). Similar results were reported by Pandey *et al.* (2004) in garden pea and Purbey and Sen (2005) in fenugreek.

Among the treatments studied foliar spray of GA_3 250 ppm recorded maximum ascorbic acid content (12.40 mg $100g^{-1}$ of fresh pod). Minimum ascorbic acid content (10.00 mg $100g^{-1}$ of fresh pod) was recorded in Cycocel 250 ppm and Cycocel 300 ppm (10.00 mg $100g^{-1}$ of fresh pod) (Table 3). Similar results were reported by Pandey *et al*. (2004) in garden pea, Purbey and Sen (2005) in fenugreek, Kokare *et al*. (2006) in okra, Sharma and Lashkari (2009) in cluster bean Foliar spray of GA_3 250 ppm increased the net photosynthetic rate by increasing number of branches, number of leaves, intermodal length, and leaf area index which might have resulted in increased the number of pods per plant, pod length, weight of 10 pods and it significantly increased the yield.

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(Received on 12.09.2011 and revised on 21.10.2011)