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Effect of plant growth regulators on morpho-physiological parameters and yield in bittergourd

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ABSTRACT

A field experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *Rabi* 2007-08 to study the effect of plant growth regulators on growth, yield and yield components in bittergourd. The experiment consisted of two varieties (MHBI-15 and Chaman Plus) and seven plant growth regulators *viz.*, three different levels of GA_3 (20, 40 and 60 ppm), NAA (50 ppm) and two levels of CCC (100 and 200 ppm) and control. The results of the investigation indicated significant differences between the treatments and varieties on vine length and number of leaves at all the stages. Among the treatments GA_3 @ 20 ppm had recorded significantly maximum vine length and number of leaves followed by GA_3 40 ppm as compared to other treatments except cycocel (100 ppm) which recorded significantly lowest in vine length and number of leaves. The experimental data revealed that the maximum fruit yield was recorded significantly with the application of GA_3 (20 ppm) follo wed by, CCC (200 ppm) as compared to other treatments and significant lowest yield was obtained in control. The increase in the fruit yield was attributed due to increase in number of female flowers per plant and number of fruits per plant. However, among the varieties, performance of Chaman Plus was superior compared to MHBI-15 in all the parameters.

Key words : Plant growth regulators

INTRODUCTION

Bittergourd (*Momordica charantia* L.) is one of the most important cucurbitaceous vegetable widely cultivated in India. The importance of bittergourd has long been recognized due to its high nutritive value and medicinal properties. In India, it is cultivated in an area of 26,004 ha with a production of 1,62,196 tons and the productivity level is 6.23 t/ha. In Karnataka, it is cultivated in an area of 1,872 ha with a production of J 3,676 tons and the productivity is 7.0 t/ha (Anonymous, 2008). Bittergourd has immense medicinal properties due to the presence of beneficial phytochemicals which is known to have antibiotic, antimutagenic, antioxidant, antiviral, antidiabetic and immune enhancing properties (Grover and Yadav, 2004). A compound known as charantin, present in the bittergourd is used in the treatment of diabetes in reducing blood sugar level (Lotlikar and Rajaramrao, 1966).

The plant growth regulators (PGRs) is considered as a new generation of agrochemicals after fertilizers, pesticides and herbicides, known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates thereby helping better fruit set. Similarly, even in bittergourd, it is possible to increase the yield level by increasing the fruit set per cent by use of some growth regulators. Use of plant growth regulators (PGRs) might be a useful alternative to increase crop production. Recently, there has been global realization of the important role of PGR's in increasing crop yield. Gibberellic acid is an important growth regulator that has many uses to modify the growth, yield and yield contributing characters of plant (Rafeekher *et al.* 2002).

Though the PGR's have great potentialities to influence plant growth morphogenesis, its application and acroal assessments have to be judiciously planned in terms of optimal concentrations, stage of application, species specificity, seasons, etc. Which constitute the major impediments in PGR's applicability. Since, very little information is available on the effect of growth regulators on growth and yield in vegetables especially in bittergourd, the present investigation was aimed to find out suitable growth regulators for increasing the fruit yield potential and also quality in bittergourd with the objective to find out the effect of plant growth regulators on growth and yield in bittergourd.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* 2007, at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to study the effect of plant growth regulators (GA_3, NAA and cycocel) on morphological parameters and yield in bittegourd. The experiment consisted of two varieties (MHBI-15 and Chaman Plus) and laid out in factorial Randomized Block Design with seven treatments *viz.*, gibberrellic acid (20, 40 and 60 ppm), naphthalene acetic acid (50 ppm), and cycocel (100 and 200 ppm). Treatments were imposed at 45 days after sowing (DAS) in both the varieties.

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The vine length was measured from the cotyledonary node upto the growing tip and expressed in centimeters. The total number of green leaves were estimated by counting the individual leaf from top to bottom of the plant was expressed as number of leaves per plant. Total numbers of female flowers produced per plant were counted in each treatment. The number of fruits per plant and fruit yield were worked out as per the standard procedures.

RESULTS AND DISCUSSION

The data on vine length presented in Table 1 indicated significant differences between the treatments and varieties at all the stages, except at 40 DAS. However, the interaction between the treatments and varieties was not significant at any of the stages. The vine length was almost doubled between 40 and 60 DAS and increased progressively thereafter. Among the varieties it was maximum in Chaman Plus compared to MHBI-I5 at all the stages (Table 1).

At 60 DAS, the maximum vine length (147.4 cm) was recorded in gibberellic acid (20 ppm) and was found significantly superior over cycocel (200 ppm) and control; while it was at par with rest of the treatments. The minimum vine length (112.7 cm) was recorded in control followed by cycocel (200 and 100 ppm) which did not differ significantly among them. The interaction effect was non significant. Among the' treatments, gibberellic acid (20 ppm) recorded significantly higher vine length (207.0 cm) over all the treatments at 75 DAS. Lower vine length was recorded in eycocel (200 ppm) which was significantly lower over all other treatments except control. The interaction effect between treatments and varieties was non significant. Similar results were also obtained by Mangal *et al.* (1981) in bittergourd.

The promotion of growth either in terms of increase in the vine length or the leaf area and leaf number has been thought to be by increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation. These osmotic driven responses under the influence of gibberellins might have attributed to increase in photosynthetic activity, accelerated translocation and efficiency of utilizing photosynthetic products, thus resulting in increased cell elongation and rapid cell division in the growing portion (Sargent, 1965).

In general, the number of leaves increased from 40 to 75 DAS, irrespective of treatments and differed significantly among the treatments at all the stages (Table 2). However, the interaction between the treatments and verities was non significant at all the stages. The numbers of leaves were found to be maximum in Chaman Plus compared to MHBI-15 at all the stage.

At 60 DAS, the numbers of leaves were maximum in gibberel1ic acid (20 ppm) and followed by gibberellic acid (40 ppm) and were significantly superior over cycocel (100 ppm), cycocel (200 ppm) and control while it was at par with rest of the treatments. The minimum number of leaves (52.9) was recorded in control followed by cycocel (100 ppm) and cycocel (200 ppm) which differed

Table 1: Influence of plant growth regulators on vine length (cm) at different stages in bittergourd

Treatments	Days after sowing								
	40			60			75		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1- Gibberellic acid (20 ppm)	59.4	62.8	61.1	125.8	169.1	147.4a	197.8	216.2	207.0a
T_2- Gibberellic acid (40 ppm)	58.8	62.0	60.4	120.4	160.1	140.2ab	194.5	214.3	204.4ab
T_3- Gibberellic acid (60 ppm)	58.0	63.5	60.7	114.0	149.7	131.8abc	190.3	209.8	200.0ab
T_4- Naphthalene acetic acid (50 ppm)	57.5	63.5	60.5	122.0	146.4	134.2abc	182.9	202.4	192.6abc
T_5- Cycocel (100 ppm)	58.5	64.2	61.3	112.5	143.4	127.9abc	175.2	197.3	186.2bc
T_6- Cycocel (200 ppm)	59.0	64.0	61.5	108.1	138.8	123.4bc	165.2	188.4	176.8c
T_7- Control	57.0	64.0	60.5	98.1	127.5	112.7c	179.4	200.5	189.9abc
Mean	58.3	63.4	60.8	114.4	147.8	131.1	183.6	204.1	193.8
For comparing means of	S.E.±		C.D. (P=0.05)	S.E.±		C.D. (P=0.05)	S.E.±		C.D. (P=0.05)
Varieties	1.6		4.6	3.7		10.9	3.1		9.0
Treatments	0.8		NS	7.0		20.3	5.8		16.9
V x T	2.2		NS	9.9		NS	8.2		NS

V_1 : MHBI-I5, V_2 : Chaman Plus, NS: Non significant

Means in the column followed by the same alphabet do not differ significantly by DMRT

Table 2: Influence of plant growth regulators on number of leaves at different stages in bittergourd

Treatments	Days after sowing								
	40			60			75		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1- Gibberellic acid (20 ppm)	46.0	46.1	46.0	64.1	66.6	65.3a	95.4	115.9	105.6a
T_2- Gibberellic acid (40 ppm)	42.6	46.0	44.3	62.2	66.4	64.3a	94.6	113.3	103.9ab
T_3- Gibberellic acid (60 ppm)	40.2	45.2	42.7	60.9	59.1	60.0abc	93.2	109.8	105.5abc
T_4- Naphthalene acetic acid (50 ppm)	44.8	45.8	45.3	63.8	61.0	62.4ab	92.5	107.5	100.0abc
T_5- Cycocel (100 ppm)	43.3	44.8	44.0	54.6	57.2	55.9bc	84.3	98.6	91.4bc
T_6- Cycocel (200 ppm)	44.4	44.8	44.6	57.7	55.2	56.4bc	81.9	95.3	88.6c
T_7- Control	43.8	43.9	43.8	54.3	52.9	53.6c	85.4	101.3	93.3abc
Mean	43.5	45.2	44.3	59.6	59.7	59.6	89.6	105.9	97.7
For comparing means of	S.E.$\pm$		C.D. (P=0.05)	S.E.$\pm$		C.D. (P=0.05)	S.E.$\pm$		C.D. (P=0.05)
Varieties	1.1		NS	1.1		NS	2.2		6.4
Treatments	2.2		NS	2.1		6.2	4.1		12.1
V x T	3.1		NS	3.0		NS	5.9		NS

V_1 : MHBI-I5, V_2 : Chaman Plus, NS: Non significant
Means in the column followed by the same alphabet do not differ significantly by DMRT

significantly among them. The interaction effect was non-significant. Among the treatments, gibberellic acid (20 ppm) recorded significantly higher number of leaves (105.6) over all the treatments at 75 DAS. Lower number of leaves was recorded in cycocel (200 ppm). The interaction effect between the treatments and varieties was non significant. Increase in the number of leaves might be due to its additional availability of GA in seed, which might have increased the level of amylase in the aleurone tissues of seed for better conversion of complex starch into simple sugars for providing energy to growth (Ram Asrey *et al.,* 2001). The decrease in both the vine length as well as number of leaves with CCC could be due to the nature of onium compounds to which CCC belongs and it is known to interfere in the GA biosynthetic pathway.

The data on number of female flowers per plant presented in Table 3 indicated significant differences between the varieties and treatments. The interaction effect between the treatments and varieties was found to be non-significant. Among the treatments number of female flowers were found to be maximum (21.4) in Chaman Plus compared to MHBI-15. Among the treatments, the number of female flowers were maximum

Table 3: Influence of plant growth regulators on yield and yield components at different stages in bittergourd

Treatments	Number of female flowers/plant			No. of fruits/ plant			Fruit yield (t/ha)		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1- Gibberellic acid (20 ppm)	19.6	21.0	20.3ab	16.4	18.3	17.3a	8.113f	9.249a	8.681a
T_2- Gibberellic acid (40 ppm)	20.5	22.3	21.4a	15.7	17.5	16.6ab	7.650i	8.922c	8.286c
T_3- Gibberellic acid (60 ppm)	20.4	22.5	21.4a	15.2	16.8	16.0bc	7.398j	8.579e	7.988e
T_4- Naphthalene acetic acid (50 ppm)	19.2	19.8	19.5b	15.6	16.7	16.1bc	7.770h	8.625e	8.197d
T_5- Cycocel (100 ppm)	20.2	22.5	21.3a	15.9	17.8	16.8ab	7.834h	8.745d	8.289c
T_6- Cycocel (200 ppm)	19.9	21.8	20.8ab	16.1	18.0	17.0ab	8.004g	9.029b	8.518b
T_7- Control	21.1	22.0	21.5a	14.9	16.1	15.5c	6.806k	7.619i	7.212f
Mean	20.1	21.7	20.9	15.6	17.3	16.4	7.653	8.680	8.165
For comparing means of	S.E.$\pm$		C.D. (P=0.05)	S.E.$\pm$		C.D. (P=0.05)	S.E.$\pm$		C.D. (P=0.05)
Varieties	0.3		0.9	0.2		0.5	0.014		0.039
Treatments	0.6		1.7	0.3		1.0	0.026		0.075
V x T	0.8		NS	0.5		NS	0.036		0.103

V_1 : MHBI-I5, V_2 : Chaman Plus, NS: Non significant
Means in the column followed by the same alphabet do not differ significantly by DMRT

in gibberellic acid (40 ppm) and gibberellic acid (60 ppm) and the minimum number of female flowers (19.5) was recorded in naphthalene acetic acid (50 ppm) compared to all other treatments which was significantly lower compared to other treatments. In general, the number of female flowers per plant was significantly lower in MHBI-15 compared to Chaman Plus in all the treatments including control. It has been observed in the present study that the application of plant growth regulators had profound influence on assimilatory surface area and its associated characters. This could be attributed to the stimulatory effect of the plant growth regulators on cell division and cell enlargement, which lead to enhanced leaf area and hence influenced the growth and development.

The fruit yield indicated significant differences between the treatments, varieties and their interaction between treatment and varieties. (Table 3) The fruit yield was found to be maximum in gibberellic acid (20 ppm) and the other treatments did not differ significantly with each other. While the minimum fruit yield was recorded in control which was significantly lower than all other treatments. The interaction between the treatments and varieties also differed significantly with gibberellic acid (20 ppm) in Chaman Plus recording maximum fruit yield followed by cycocel (200 ppm). In general, the fruit yield was significantly lower in MHBI-15 compared to Chaman Plus in all the treatments. An increase in fruit yield in treated plants may further be attributed to the reason that plants remain physiologically 'more active to build up sufficient assimilates for the developing flowers and fruits, ultimately leading to higher yield. The increase in fruit yield by GA_3 is probably due to an increase in carbohydrate metabolism and accumulation of carbohydrates (Mishra *et al.,* 1972), auxin directed mobilization of metubolites from source to sink (Vasantkumar and Sreekumar, 1981).

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