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EFFECT OF FOLIAR APPLICATION OF IAA AND GA_3 ON SEX EXPRESSION, YIELD ATTRIBUTES AND YIELD OF BITTER GOURD (*MOMORDICA CHARANTIA* L.)

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ABSTRACT

Three concentrations of each of IAA viz. 2.5 (T_1), 5.0 (T_2) and 10 (T_3) ppm and GA_3 viz. 2.5 (T_4), 5.0 (T_5) and 10 (T_6) ppm were applied as foliar spray on bitter gourd. Results showed a positive stimulatory effect in the increase of female flowers at T_3 where the male to female sex ratio was the lowest. The number of fruits, fresh weight of fruits and yield per plant were also found to be the highest at T_3.

Key words: Bitter gourd, sex expression, yield, IAA, GA_3.

INTRODUCTION

Momordica charantia L. a member of the family Cucurbitaceae is a native of tropical regions of Asia with extensive distribution in China, Japan, South East Asia, Polynesia and also in Africa (Jeffery 1967). The immature fruits are a good source of vitamin C and provide some vitamin A, phosphorus and iron. It is fast growing, trailing or climbing with their stem and tendrils. It is an economically important plant as it is used to combat for cancer, diabetes and many infectious diseases (Shetty *et al.* 2005). It is a powerful weapon against immunodeficiency virus (HIV) (Sikder 2004). The average yield of bitter gourd is 13.84 mt per hectare which seems to be low (BBS 2005). In cucurbits male flowers are found to bloom at the lower nodes and female flowers appear a week later and never bloom first before the male flowers (Sumpoudlek and Abella 1974). As a crop bitter gourd has a number of problems viz. low seed germination, small and D-shaped fruit, low yield, non-synchronous flowering and diseases (Sikder 2004).

Plant growth regulators like IAA and GA_3 have remarkable effect on the sex expressions and yield and fruit characteristics in cucurbitaceous crops. But information on the application of foliar spray of these two phytohormones in

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bitter gourd are scanty. The present investigation was undertaken to study effects of foliar spray of different concentration of IAA and GA_3 on the number of female flowers, male to female sex ratio, yield and yield attributes of bitter gourd.

MATERIALS AND METHODS

A pot experiment was carried out in *Kharif* season during 2009 in the department of Botany, University of Chittagong. The seeds of bitter gourd var. Shahparan were collected from the Society Nursery, Chittagong, Bangladesh.

There were altogether seven treatments viz. T_0 (Control), T_1-2.5 ppm IAA, T_2-5.0 ppm IAA, T_3-10 ppm IAA, T_4.2.5 ppm GA_3, T_5-5.0 ppm GA_3 and T_6-10 ppm GA_3. A trireplicated RCBD (Randomized Complete Block Design) was maintained in the present investigation. There were 3 pots per treatment and total number of pots was 21. Each pot measures 30 cm × 30 cm and filled up with a mixture of 10 kg loamy soil, 5 kg decomposed cowdung, 200 g T.S.P and 115 g M.P. following Paleda and Chang (2003) and left in sun for 7 days. Five seeds were sown in each pot on March 5, 2009. The average percentage of germination was above 80. After germination three uniform seedlings were kept per pot and the rests were thinned out. Irrigation, weeding and other cultural practices were done as and when required.

The above mentioned concentration of IAA and GA_3 were sprayed on a sunny morning when seedlings were at four leaf stage. The control plants (T_0) were sprayed with only distilled water. The number of male and female flowers (opened and bud condition) were counted and continued at 15 days interval till final harvest. The male to female sex ratio was calculated. Node number at which first male and female flowers appeared were also recorded. The fruits of bitter gourd were harvested at marketable stage. The numbers of fruits per plant, fresh weight, length, flesh thickness, cavity, diameter, circumference per fruit were measured just immediately after harvest. The yield per plant was calculated by multiplying the number of fruits per plant and fresh weight per fruit. Analysis of variance (ANOVA) was done to show the significant differences among the treatments.

RESULTS AND DISCUSSION

Different concentrations of IAA and GA_3 were found effective in the increase of male and female flowers, yield attributes and yield of bitter gourd. The results are presented in Table 1, 2 and 3.

As compared to control the number of female flowers increased significantly following growth regulator treatments except at T_1 and T_6. At T_1 and T_6 non-significant increases were found. The highest number of female flowers was found at T_3 (Table 1). The increase in number of female flowers due to application of asafoetida and GA_3 were reported by Choudhury and Elkholy (1970) in water melon and Kalia and Dhillon (1966) in *Lagenaria siceraria*, respectively. This corroborates with the findings of Ghosh and Basu (1983) who obtained increased number of female flowers due to application of IAA in bitter gourd. Rahman and Shormeen (1999) reported increase of number of female flowers in sweet gourd due to application of IAA. This observation corroborates with the findings of Ashrafuzzaman *et al*. (2009) who also obtained increased number of female flowers in bitter gourd due to the application of GABA. According to Shannon and Guarding (1969) the effect of auxin on sex expression is through an ethylene formation process. Iwahori *et al.* (1970) reported enhanced female sex expression in cucurbits following several growth regulators.

The number of male flowers decreased significantly at T_2, T_3 T_4 and T_6. The lowest number of male flowers was found at T_3 (Table 1). The suppression of number of male flowers was also reported by Gaur and Joshi (1965) with IAA application on *Lagenaria siceraria* and Surendranath and Rao (1981) in cucumber following application of growth regulators. The total number of flowers decreased following all the treatments except at T_5, but significantly decreased at T_3 and T_6. (Table 1).

The male flower appeared at significantly lower number of nodes in all the treatments except at T_6 but the difference at T_6 was nonsignificant. Male flowers appeared at the lowest number of nodes at T_3. The female flower also appeared at significantly lower number of nodes in all the treatments from control. The appearance of first female flowers at lower node due to IAA treatment of the present investigation was consistent with the findings of Gaur and Joshi (1965). Different concentrations of IAA and GA_3 initiated lower male to female sex ratio from control and the lowest male to female sex ratio was found in T_3 (Table 1). The highest male to female sex ratio was in T_0. This agrees with the findings of Ashrafuzzaman *et al*. (2009). The decrease of male to female sex ratio due to IAA

application is similar to the findings of Rahman *et al.* (1992). According to Surendranath and Rao (1981) the ratio of male and female flowers is determined by a balance of auxin and gibberellin; the balance in favor of auxin resulting in the formation of female and the latter of male flowers.

TABLE 1: EFFECT OF FOLIAR SPRAY OF IAA AND GA_3 AT FOUR LEAF STAGE ON NUMBER OF FLOWERS, NODE AT WHICH FIRST FLOWER APPEARED AND MALE TO FEMALE SEX RATIO OF *MOMORDICA CHARANTIA* VAR. SHAHPARAN.

Treatments	Number of flowers/plant			Node at which first flower appeared		Sex ratio (M/F)
	Male (M)	Female (F)	Total flowers (M+F)	M	F	
T_0 (control)	43.50c	12.33a	55.83d	12.66d	28.50f	3.52e
T_1 (2.5ppm IAA)	42.25bc	13.00ab	55.25b	8.0a	18.00b	3.25d
T_2 (5ppm IAA)	41.50b	14.00b	55.00d	9.33b	19.50c	2.93c
T_3 (10ppm IAA)	36.00a	16.50c	52.50c	7.66a	16.00a	2.18a
T_4 (2.5ppmGA_3	41.50b	14.00b	55.50d	9.00b	21.05d	2.96c
T_5 (5ppm GA_3)	42.00bc	15.00b	57.00d	11.33d	25.00e	2.80b
T_6 (10ppm GA_3)	36.50a	12.66a	49.16a	12.00cd	19.60c	2.88b
S.E.±	0.97	0.73	1.14	0.47	0.40	0.05
LSD0.05	1.72	1.30	2.03	0.83	0.71	0.08

Means followed by a common letter(s) are not significantly different at the 5% level.

It was revealed from table 2 that the length of fruit significantly increased in all the treatments except at T_4. The highest length of fruit was obtained at T_3. The flesh thickness increased in all the treatments except at T_6 and the highest was at T_3. The cavity per fruit increased significantly in all the treatments except at T_5. The circumference and diameter per fruit significantly increased in all the treatments and the highest value was found at T_3.

TABLE-2: EFFECT OF DIFFERENT CONCENTRATION OF FOLIAR SPRAY OF IAA AND GA_3 AT FOUR LEAF STAGE ON THE FRUIT CHARACTERS OF *MOMORDICA CHARANTIA* VAR. SHAHPARAN.

Treatments	Length (cm)	Flesh thickness/ fruit (cm)	Cavity/fruit (cm)	Circumference (cm)	Diameter (cm)
T_0	14.21a	0.99a	2.20a	11.17a	2.82a
T_1	19.20cd	1.01abc	2.46bc	11.43c	3.00b
T_2	18.09bc	1.03bc	2.38b	11.53d	3.02b
T_3	19.88cd	1.09d	2.55c	11.88f	3.11d
T_4	15.44ab	1.03bc	2.38b	11.66e	3.06bcd
T_5	18.33bcd	1.04c	2.19a	11.68e	3.10cd
T_6	17.57bc	0.98a	2.45b	11.34b	3.01b
S.E±	0.98	0.02	0.03	0.03	0.10
LSD0.05	1.74	0.03	0.09	0.05	0.17

Means followed by a common letter(s) are not significantly different at the 5% level.

Results presented in table 3 shows that the number of fruits per plant though increased in all the treatments from control but significantly increased at T_1, T_3 and T_5. The highest number of fruits per plant was at T_3. The fresh weight per fruit significantly increased in all the treatments except at T_1 and the highest was at T_3. The yield per plant significantly increased at T_2, T_3, T_5 and T_6. The highest yield per plant was at T_3 where number of fruits and fresh weight of fruits were also highest. The increase in yield due to IAA application of the present investigation agrees with the findings of Choudhury and Babel (1965) and Rahman *et. al.*(1992) on bottle gourd.

TABLE 3: EFFECT OF DIFFERENT LEVELS OF FOLIAR SPRAY OF IAA AND GA_3 AT FOUR LEAF STAGE ON NUMBER OF FRUIT, FRESH WEIGHT, NO. OF SEEDS AND YIELD OF *MOMORDICA CHARANTIA* VAR. SHAHPARAN.

Treatments (T)	No. of fruits /plant	Fresh weight/fruit (gm)	Yield kg/plant
T_0	10.00a	74.51a	0.74b
T_1	11.00b	74.52a	0.51a
T_2	10.66ab	79.39c	0.84c
T_3	12.33c	79.83c	0.98e
T_4	10.00a	77.94b	0.77b
T_5	11.66bc	78.60bc	0.91d
T_6	10.66ab	77.67b	0.82c
S.E±	0.44	0.74	0.04
LSD0.05	0.78	1.31	0.07

Means followed by a common letters(s) are not significantly different at the 5% level.

Auxins and a number of plant growth regulators are known to cause physiological modifications in plants mainly on flowering behavior, sex ratio, increased fruit set, enlargement and development of fruits, and source-sink relation. Growth regulators bring certain changes in metabolism during fruit and seed development due to which there would be greater accumulation of food reserves resulting in higher yield. These beneficial effects of chemicals were also reported by Das and Das (1995) in pumpkin, Sitaram *et al.* (1988) and Rafeekher *et al.* (2002) in cucumber, Gedam *et al.* (1998) in bitter gourd and Balaraj (1999) in chilli.

In the present investigation T_3 concentration was found the most effective for the increase of number of female flowers and decrease of male to female sex ratio where the female flowers appeared at the lowest number of nodes of main vine. The number of fruits per plant and fresh weight per fruit were also found the highest in T_3 which resulted the maximum yield per plant.

So, with the use of suitable concentration of IAA and GA_3, keeping all other cultural practices at optimum level, it is possible to manipulate sex

expression of bitter gourd and thereby good economic benefit may be achieved by increasing the number of female flowers with ultimate increase in yield.

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