PLANT GROWTH REGULATORS AFFECTING SEX EXPRESSION OF BOTTLE GOURD (*LAGENARIA SICERARIA* MOLINA) PLANTS

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ABSTRACT:- The effect of exogenous application of various levels of ethrel (500, 1000, 1500 and 2000 µmol l^{-1}); Gibberrelic Acid (GA_3; 15, 30, 45 and 60 µmol l^{-1}) and Maleic hydrazide (MH; 200, 400, 600 and 800 µmol l^{-1}) on sex expression of bottle gourd *(Lagenaria siceraria* Molina*)* plants cv. Faisalabad Round was investigated under field conditions in National Agricultural Research Centre, Islamabad. Plants sprayed with distilled water were considered as control. Among all foliar agents, the response of GA_3 and MH was found better. Exogenous application with 30 µmol l^{-1} GA_3 maximally increased the pistillate flower production as compared to control. Moreover, the treatment produced maximum number of fruits (22.24 plant^{-1}) and fruit weight (6.31 kg plant^{-1}). However, foliar spray with different combinations of ethrel did not improve yield and yield contributing attributes.

*Key Words: Bottle gourd; Sex Expression; Ethrel; Gibberrelic Acid; Maleic Hydrazide; Yield; Yield Com*ponents; *Pakistan.*

INTRODUCTION

Bottle gourd (*Lagenaria siceraria* Molina) is a commonly grown vegetable of Pakistan and belongs to Family Cucurbitacea. It is cultivated on 5971 ha and production is 63173t (GOP, 2009-10). Average national yield is 10.6 t ha^{-1}. Besides many other reasons for low yield, there is one problem of fewer pistillate flowers and high sex ratio. In cucurbitaceous plants, sex expression such as time of flowering, sex of flowers, number of flowers of different sexes, sex ratio, etc. are determined by gene as well as the environment. Huyskens et al. (1992) reported that significantly more female flowers were produced during spring-summer, under long days and high temperature, than in autumn-winter under short days and low temperature conditions. Plant growth regulators are found beneficial for induction of pistillate flowers and reduction of staminate flowers in bottle gourd. Sex expression can also be controlled by changing the environment and by using different growth regulators. Commonly available hormones, responsible for flowering in plant body are auxins, gibberellins, cytokinins, ethylene, abscisic acid.

Some growth regulators promote femaleness, while some others promote maleness. Kooner et al. *(*2000) reported that ethrel and MH affect growth and sex expression in bottle gourd. Rahman and Karim (1997) reported that number of female flowers, fresh weight of fruit and yield per plant were highest when a combination of 100 ppm Naphthalene

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acetic acid (NAA) 75 ppm; 2,3,5-triiodobenzoic acid (TIBA) and 50 ppm GA_3 was applied. Ying et al. (1994) reported that sex expression of bottle gourd flowers can be modified by plant growth regulators. Mandal et al. (1991) sprayed the seedlings of bottle gourd with different plant growth regulators to observe their effect on sex expression. Arora et al. (1987) reported that MH at 150 mg l^{-1} had a profound effect on the earliest appearance of pistillate flowers at the lowest node number. Male: female ratio was lowered with MH at 50 mg l^{-1} and was most effective in producing the maximum number of fruits and fruit weight per plant and ultimately the yield. Saimbhi and Thakur (2006) applied single aqueous sprays of 2-chloroethyl- phosphonic acid (CEPA) 250, 500 and 1000 $mg1^{-1}$; TIBA 25, 50 and 100 $mg1^{-1}$; and (2-chloroethyl) trimethyl-ammonium chloride (CCC) 250, 500 and 1000 $mg1^{-1}$ were applied to squash melon (*Citrullus vulgaris* Schrad. var. *fistu-losus* Stocks.) at the 23 leaf stage. The CEPA decreased while both TIBA @ 25 and 50 $mg1^{-1}$, and CCC 500 $mg1^{-1}$ increased the number of fruits per plant and the yield. Foliar spray of ethephon (100-500 $mg1^{-1}$), GA_3 (10 $mg1^{-1}$), MH (50 - 150 $mg1^{-1}$) and TIBA (25-50 $mg1^{-1}$) increased the yield in most of the cucurbits (Sonkar 2003; Jatoi et al., 2010). Singh and Choudhury (1983) observed that ethrel at 50 and 100 ppm induced first pistillate flower earlier and at lower nodes in bottle gourd and also lowered the sex ratio as compared to the control. Therefore, a study was undertaken to assess the effects of plant growth regulators (ethrel, GA_3 and MH) to narrow the sex ratio by the increase in pistillate flowers per plant for yield improvement in bottle gourd cv. Faisalabad Round.

MATERIALS AND METHOD

Seeds of bottle gourd (Lagenaria siceraria Molina) cultivar 'Faisalabad Round' were sown in growing media (mixture of soil, sand and FYM) during March for raising nursery. Seedlings were protected from the attack of red pumpkin beetle with the application of sevin dust and ash in the 1:10 ratio. Healthy seedlings at 2-3 leaves stage were transplanted in the field during first week of April. Field was already prepared one month before transplanting and FYM @ 15 tha^{-1} was ploughed down at the time of land preparation. The soil was clay loam in texture. Plants were spaced at 2 m x 0.6 m. Plot size was 8 m^2. A standard package of cultural practices recommended for open field crop was followed.

Crop was sprayed at two-leaf stage with ethrel (500, 1000, 1500 and 2000 µmol l^{-1}), GA_3 (15, 30, 45 and 60 µmol l^{-1}) and MH (200, 400, 600 and 800 µmol l^{-1}). Randomized complete block design with three replications was used for treatments. Control plants were sprayed with distilled water.

The observations on each plant for number of pistilllate flowers, number and weight of fruits per plant and yield per plant were recorded. The sequential pickings started from second week of May. Statistical analysis was carried out with MSTAT-C to construct ANOVA using Duncan's Multiple Range Test to determine significance of the (Steel et al., 1996).

RESULTS AND DISCUSSION

Number of Pistillate Flowers

Gibberellic acid (GA_3) and MH (Maleic hydrazide) significantly increased the number of pistillate flowers per plant as compared to control and ethylene treatments. Maximum number of pistillate flower per plant (24.9) were recorded with GA_3@ 30 µmol l^{-1} followed by GA_3@ 15 µmol^{-1} as compared to control (10.2) (Figure 1). Hidayatullah et al. (2011) reported that GA_3 significantly increased total number of pistillate flowers in cucumber. Rahman and Karim (1997) however, got similar results by applying 50 ppm GA_3 in combination with 100 ppm NAA and 75 ppm TIBA.

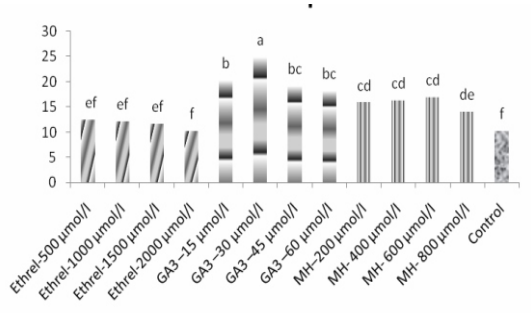

Figure 1. Effect of foliar spray with plant growth regulators on pistillate flowers per plant

Number of Staminate Flowers

All gibberellic acid (GA_3) treatments increased the staminate flowers as compared to control, ethrel and maleic hydrazide. However, GA_3@ 30 and 15 µmol l^{-1} gave highest number of staminate flowers per plant (Figure 2). Lower concentration of ethrel also significantly increased the staminate flowers. With the increase in concentration of ethrel there is a significant decrease in number of staminate flowers recorded. On the other hand MH brought no change and the results had no significant difference with control. Mandal et al. (1991) reported an increase in the number of male flowers in bottle gourd cv Pusa Summer Prolific Long by the application of GA (25 and 50 ppm), ethrel (10 and 20 ppm) and MH (100 ppm).

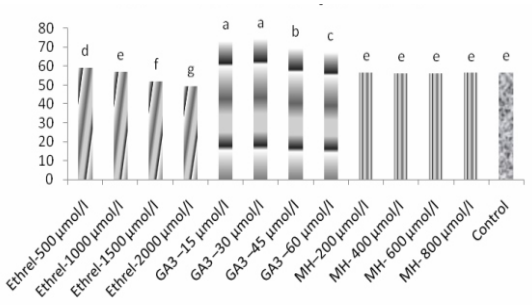

Figure 2. Effect of foliar spray with plant growth regulators on staminate flowers per plant

Sex Ratio

Except ethrel 2000 µmol l^{-1} all remaining treatments decreased the sex ratio significantly. The lowest sex ratio was recorded in GA_3@ 30 µmol l^{-1} (Figure 3). All hormonal treatments showed at par results among each other. Singh and Choudhury (1983) reported that ethrel 100 ppm produced the lowest sex-ratio in bottle gourd. Arora et al. (1987) reported that male: female ratio was lowered with MH at 50 mg l^{-1}

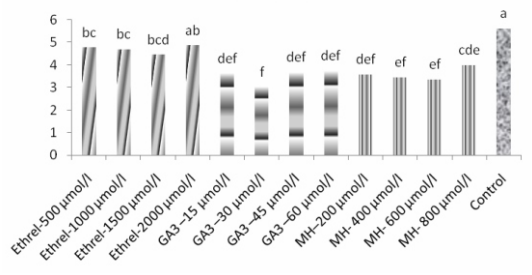

Figure 3. Effect of foliar spray with plant growth regulators on sex ratio

Number of Fruits per Plant

All GA_3 and MH treatments significantly increased fruit number per plant. Maximum fruits/plant (22.2) was recorded when sprayed with 30 µmol l^{-1} GA_3 as compared with control (8.6). GA_3 was found most effective in increasing fruit number per plant followed by MH. Moreover, foliar application with ethrel did not improve number of fruits in present Study (Figure 4). This may be due to the positive correlation (0.997) of number of fruits/plant with number of pistillate flowers (Table 1). Arora et al (1987) reported that MH at 150 mg l^{-1} had a profound effect in producing the maximum number of fruits.

Table 1. Correlation coefficient for the effect of foliar spray of plant growth regulators on sex expression and yield in bottle gourd cv. Faisalabad Round

	Pistillate flower per plant	Sex ratio	Number of fruits per plant	Fruit weight per plant (kg)	Yield (t ha^{-1})
Pistillate flower per plant	1	0.861	0.997	0.966	0.966
sex ratio		1	-0.863	-0.829	0.829
Number of fruits per plant			1	0.969	0.969
fruit weight per plant (kg)				1	1

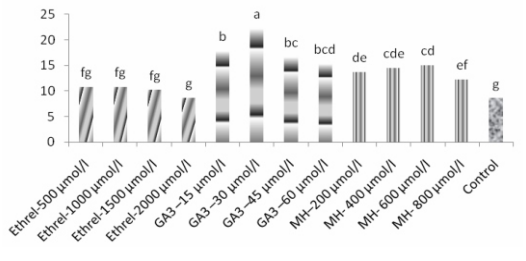

Figure 4. Effect of foliar spray with plant growth regulators on number of fruits per plant

Fruit Weight per Plant and Yield

Maximum fruit weight $plant^{-1}$ (6.3 kg) and yield (52.6 tha^{-1}) was recorded in plants exposed to 30 µmol l^{-1} GA_3 followed by 15 µmol l^{-1} GA_3 (Figure 5). Rahman and Karim (1997) reported that fresh weight of fruit and

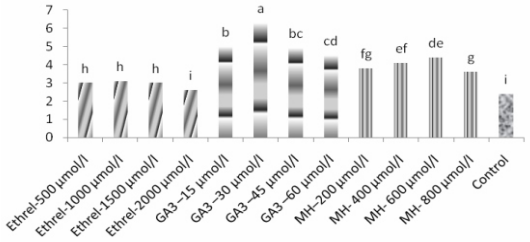

Figure 5. Effect of foliar spray with plant growth regulators on fruit weight per plant

yield per plant were highest when a combination of 100 ppm NAA, 75 ppm TIBA and 50 ppm GA_3 was applied. Arora et al. (1987) reported that MH at 150 mg l^{-1} was most effective in producing the maximum fruit weight per plant and ultimately the yield. Foliar spray of MH (50-150 mgl^{-1}) increased the yield in most of the cucurbits (Sonkar, 2003; Jatoi et al., 2010 & 2011).

It is evident from the study that GA_3 and MH gave better result as compared to ethrel. It is therefore concluded that GA_3 30 µmol l^{-1} proved best and increased the pistillate flowers, number of fruits and fruit weight per plant as compared to control.

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