JOURNAL OF PURE AND APPLIED MICROBIOLOGY, Dec. 2015. Vol. **9**(4), p. 3099-3102

Effects of Plant Growth Regulators on Flowering, Fruiting and Fruit Yield in Bitter Gourd (*Momordica charantia* L.)

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(Received: 06 April 2015; accepted: 11 July 2015)

The effect of exogenous application of various levels of Gibberrelic Acid (GA_3 ; 25 and 50 ppm), ethrel (250 and 500 ppm), Naphthalic Acetic Acid (NAA; 50 and 100 ppm) and Cycocel (CCC; 100 and 200 ppm) on flowering fruiting and fruit yield in bitter gourd (*Momordica charantia* L.) plants cv. Phule Green Gold was investigated under field conditions in Junagadh Agricultural University Junagadh. Among all the foliar agents, the response of GA_3 and ethrel was found better. Exogenous application of ethrel 500 ppm were observed lowest node number (22.13) on which first female flower appered as compared to control. Moreover, the treatment GA_3 50 ppm produced maximum number of fruits (8.85 per vine), fruit weight (66.14g) and matured fruit yield (0.59 kg). However, foliar spray with different combinations of CCC did not improve yield and yield contributing attributes.

Key Words: Bitter gourd, Gibberrelic Acid, Ethrel, Naphthalic, Acetic Acid (NAA), Cycocel (CCC) and Yield.

Bitter gourd (*Momordica charantia* L.) is commonly grown vegetable of Gujarat and belongs to family Cucurbitacea. Gourds were cultivated on about 9,205 thousand hectares with production of 162,187 million tonnes (Anonymous, 2013). 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 genes as well as the environment.

Bitter gourd is a different nature's bountiful gifts to mankind which not only have fabulous digestional properties, it is a store house of remedies for many common ailment. Fruits, leaves and even the roots of this vegetable have been used in ayurveda for number of diseases. It has immense medicinal properties due to the presence of beneficial phytochemicals, which are known to have antibiotic, antimutagenic, antioxidant, antiviral, antidiabetic and immune enhancing properties. A compound known as 'charantin', present in the bitter gourd is used in the treatment of diabetes in reducing blood sugar level.

The lowest number of node on which first female flower appeared was recorded in ethrel 500 ppm. This may be probably due to retardation of starch digestion, transpiration as well as respiration in plant tissue after ethrel treatment, thereby considerable starch remains for a longer period. Further, during flowering the formation of pistillate organs may be favoured by high auxin level in the vicinity of differentiating primordia.

Plant growth regulators are found beneficial for induction of pistillate flowers and reduction of staminate flowers in bitter gourd. Sex expression can also be controlled by changing the environment and by using different growth

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regulators. Commonly available hormones, responsible for flowering in plant body are auxins, gibberellins, cytokinins, ethylene, abscisic acid. Therefore, the present investigation was under taken by using plant growth regulators

MATERIALS AND METHODS

Seeds of bitter gourd (*Momordica charentia* L.) cultivar 'Phule Green Gold' were sown in field during first week of February. Field was prepared one month before sowing and FYM @ 15 t ha^{-1} was ploughed down at the time of land preparation. The soil was clay loam in texture. Plants were spaced at 2 m x 1 m. Split plot design with three replications was used for treatments. A standard package of cultural practices recommended for open field crop was followed.

Plant growth stages were allotted to main plot and plant growth regulators assigned to sub plot. Plants were sprayed at two-leaf stage (M_1), flower initiation stage (M_2) and fifteen days after flower initiation stage (M_3) with Four growth regulators each with two concentrations *viz.*, Gibberrelic Acid, Ethrel Naphthalic Acetic Acid (NAA) and Cycocel (CCC) were used for foliar application with water spray and control (no spray) makes total 10 treatment viz., GA_3 25 ppm (S_1), GA_3 50 ppm (S_2), Ethrel 250 ppm (S_3), Ethrel 500 ppm (S_4), NAA 50 ppm (S_5), NAA 100 ppm (S_6), CCC 100 ppm (S_7), CCC 200 ppm (S_8), water spray (S_9), control (no spray) (S_{10}).

Five plants were selected from each plot to take the observations during each stage. The sequential pickings started from second week of may up to at an interval of 15 days. Statistical analysis of split plot design was carried out as per Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Number of node on which first female flower apperead

Ethrel treatments significantly lowered number of node on which first female flower appeared as compared to both controls. The application of ethrel 500 ppm exerted significantly the lowest node number (22.13) on which first female flower appeared. (Fig. 1). Verma *et al.* (1984) reported that ethrel 100 ppm induced the first staminate and pistillate flower at the lowest nodes (6.5 and 9.5, respectively) in bitter gourd; Singh and Choudhary (1983) reported that ethrel at 50 and 100 ppm induced first pistillate flower earlier and lower nodes in bottle gourd, while Arora *et al.* (1987) reported that MH at 150 mg/l had a profound effect on the earliest appearance of pistillate flowers at the lowest node number in bottle gourd Sreeramulu (1987) observed that etherel at 100 mg/l not only increase the pistillate flowers, but also fastened the appearance of the first female flower in sponge gourd. Similarly, Al-Masoum and Al-Masri (1999) reported that plants treated with ethephon at 250, 350 and 450 ppm sprayed at seedling stage (two to four true leaves stage), produced late number of nodes to the first female flowers with more numbers in cucumber.

Number of node on which first male flower appeared

GA_3 treatments significantly lowered number of node on which first female flower appeared as compared to both controls. Application of GA_3 @ 50 ppm exerted significantly the lowest node number (8.30) on which first male flower appeared it was remained at par with treatment GA_3 25 ppm (S_1) (8.32), ethrel 250 ppm (S_3) (8.86).(Fig. 2).

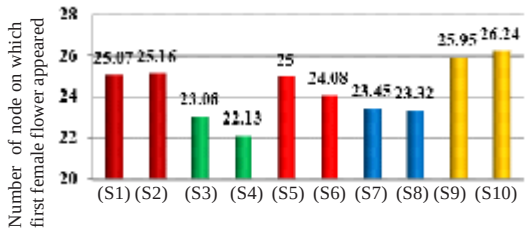

Fig. 1. Effect of plant growth regulators on number of node on which first female flower appeared in bitter gourd cv.Phule Green Gold

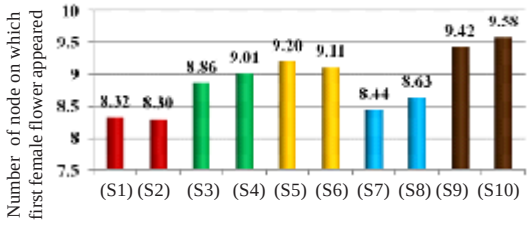

Fig. 2. Effect of plant growth regulators on number of node on which first male flower appeared in bitter gourd cv.Phule Green Gold

Verma *et al.* (1984a) and Damodhar *et al.* (2004) reported that ethrel 100 ppm and GA_3 50 ppm, respectively induced the first staminate flower at the lowest node in bitter gourd; and Arora *et al.* (1987) in ridge gourd and Shirzad *et al.* (2012) in pumpkin observed induction of male flower at lowest node number with application of ethrel @ 100 ppm, and GA3 @ 25 ppm respectively.

Number of mature fruits per plant

All the GA_3 treatments significantly increased fruit number per plant. application of GA_3 at 50 ppm (S_2) gave the higher number of matured fruits per plant (8.85) it was at par with the treatment GA_3 25 ppm(S_1) (8.58) as compared to control (5.32) The increase in the fruit yield by more number of matured fruits with GA_3 @ 50 ppm might be due to the effect of GA_3 to cause physiological modification in the plants mainly on sex expression, sex ratio, increased fruit set, enlargement and development of fruits and also higher photosynthetic activity, synthesis and translocation of metabolites from source to sink points. Momin *et al.* (2013) and Mia *et al.* (2014) reported that application of different plant growth regulators was most effective to increase the number of fruit due to more number of pistillate flowers and fruit set per vine in bitter gourd.

Average fruit weight (g)

Plants sprayed with GA_3 at 50 ppm exerted significantly the maximum average fruit weight (66.14 g) which was at par with GA_3 25 ppm (S_1) (63.71 g) as compare to control (49.48 g). Hossain *et al*. (2006). observed that the application of GA_3 @ 25 ppm had produced the maximum average fruit weight (10.75 g) and total yield per plant (1.63 kg).

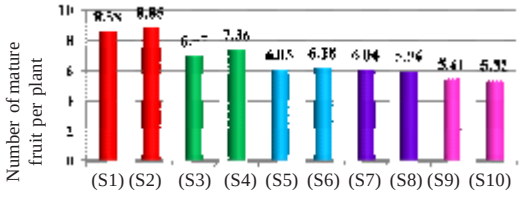

Fig. 3. Effect of plant growth regulators on matured fruit per plant in bitter gourd cv. Green gold

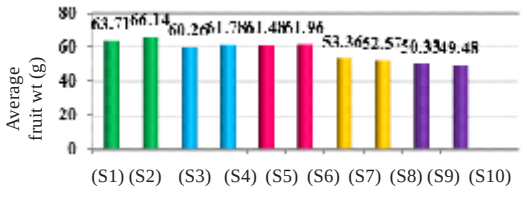

Fig. 4. Effect of plant growth regulators on average fruit wt. (g) in bitter gourd cv. Phule Green Gold

Matured fruit yield per plant (kg)

Application of GA_3 50 ppm, (S_2) had registered first position by producing significantly the maximum matured fruit yield per plant (0.59 kg) as compare to (0.28 kg) control (S_{10}) (0.28 kg) and it was remained at par with water spray (S_9) (0.30 kg). The yield in bitter gourd was found to be strongly influenced by the application of different growth regulators, thus indicating the importance of these compounds in increasing the yield potential through their effect on various morpho-physiological and biochemical traits. Among them, the maximum yield was noticed with gibberellins. This could be attributed to the stimulatory effect of GA_3 on cell division and cell elongation. From the findings it is evident that there is increase in vine length, leaf number and leaf area thereby providing more sources for the better development of sinks. Gibberellic acid is a natural plant hormone which is synthesized in plants and it is well known that the application of GA_3 improves fruit yield and quality in many cucurbitaceous and other horticultural crops. The maximum matured fruit yield was obtained due to application of GA_3 20, 25 and 40 ppm by Biradar *et al.* (2010), Hossain *et al.* (2006) and Shantappa *et al.* (2005) and Ripen-15 at 200 ppm by Momin *et al.* (2013) in bitter gourd; GA_3 at 30 ppm by Hidayatullah *et al.* (2012) in bottle gourd; GA_3 at 50 ppm by Hilli *et al.* (2010) and GA_3 at 25 ppm by Batlang *et al.* (2006) in cucumber; and GA_3 at 25 ppm by Shirzad *et al.* (2012) in pumpkin, which are in conformity with the present results.

It is evident from the study that GA_3 and ethrel gave better result as compared to CCC. It is

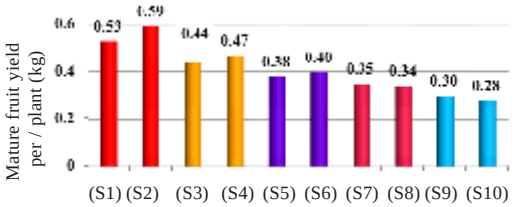

Fig.5. Effect of plant growth regulators on matured fruit yield per /plant (kg) of bitter gourd cv. Phule Green Gold.

therefore concluded that ethrel 500 ppm proved best to produce lowest node on which first female flower appeared and GA_3 50 ppm increased the number of fruits, fruit weight and fruit yield as compared to control.

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