International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 964-966

Received: 13-09-2017
Accepted: 16-10-2017

B Sakthinathan
PG Scholar, Department of Horticulture, AC & RI, TNAU, Madurai, Tamil Nadu, India

V Swaminathan
Dean, HC & RI, TNAU, Periyakulam, Tamil Nadu, India

P Balasubramanian
Assistant Professor, Department of Farm Management, AC & RI, TNAU, Madurai, Tamil Nadu, India

T Sivakumar
Assistant Professor, Department of Seed Science and Technology, AC & RI, TNAU, Madurai, Tamil Nadu, India

Correspondence
B Sakthinathan
PG Scholar, Department of Horticulture, AC & RI, TNAU, Madurai, Tamil Nadu, India

Effect of ethrel on sex expression in pumpkin (*Cucurbita moschata* L.)

B Sakthinathan, V Swaminathan, P Balasubramanian and T Sivakumar

Abstract
Vegetables especially Cucurbits play a vital role in ensuring the nutritional security of the humans. Pumpkin (*Cucurbita moschata* L., 2n = 2x = 40) is one of the most popular warm season vegetable among the cucurbits because of its immense nutraceutical value. Considering this criteria, the present study was focused on increasing the production of pumpkin fruit yield by adopting economically viable technique, by which the farmers can benefit massively. The present study was carried out with the application of growth regulator ethrel (250 ppm) on five different cultivars (CO 1, Pumpkin big, Yellow big, Pennadam local and Melur local) of pumpkin with two stage of application (3 -4 leaf stage and 15 days after first spray) along with control. The result of the study revealed that spraying of ethrel @ 250 ppm at 3-4 leaf stage and 15 days after the first spray highly influences on sex modification in yellow big cultivar than other cultivars. Spraying of ethrel (250 ppm) significantly enhanced the growth parameters and yield by recing the staminate / male flowers and increasing the female/pistillate flowers.

Keywords: vegetables, cucurbits, pumpkin, ethrel, pistillate, staminate

Introduction
Pumpkin is a highly relished cucurbit because it is one of the most important vegetable crops grown extensively during spring-summer, summer-rainy and early autumn seasons throughout the tropical and subtropical parts of the country. Pumpkin is a warm season crop and susceptible to frost. The favorable temperature range for the growth and development is minimum 18-30^{0}C. Pumpkin is highly cross pollinated in nature due to monoecious sex form and entomophilies pollination. Short days, comparatively low night temperature and high relative humidity is the best for pumpkin cultivation as this condition increases the propensity of pistillate flowers in the vine. High temperature and long day helps to increase the number of staminate flowers and reduce the number of pistillate flowers. Pumpkin flower biology and sex expression are important traits for breeding activities to obtain higher production (Pappaiah and Muthuswamy, 1978) [8].

Due to its high nutritional content and lucrative market price, pumpkin may be considered as a high value crop. Pumpkin occupies a prominent place among the vegetables owing to its productivity, nutritive value, good storability, long period of availability and better transport potentialities. It is mandatory to focus on increasing the yield by sex modification with external factor by application of growth regulators, especially ethylene.

The Plant growth regulators play an important role in both morphology and physiology of the plants. The effect of growth regulator varies with plant species, variety, their growth stage, concentration of chemicals, application method and frequency of application (Ram Ashrey *et al*. 2001) [9]. Growth retardant like ethrel is the substance that slows down the cell division and cell elongation in meristamatic tissue of shoot and regulate the plant height without change in the morphology and physiology of the plant. Growth regulators can alter the sex ratio and sequence if applied at the two- or four-leaf stage, which is the critical stage at which the suppression or promotion of either sex is possible (Hossain *et al.,* 2006) [4].

Ethylene is a gaseous hormone which stimulates growth and alters the sex expression character of cucurbits. Ethephon (2-chloroethyl phosphoric acid) is an ethylene-releasing compound, and it is widely used as a plant growth regulator (Domir and Foy., 1978) [3]. The effect of the application of exogenous gaseous ethylene or ethepon solution varies with plant species, chemical concentrations, timing and duration of application. Ethephon regulates phases of plant growth and development by application to various growth sites.

The seedlings of poinsettee variety of cucumber sprayed with ethrel (400 mgl^{-1}) at four to six leaf stage significantly increased the number of female flowers per plant (35.23) and reduced the sex ratio (3.69) compared to control 19.8 and 224.5, respectively (Vadigeri *et al.*, 2001) [15]. The ethrel (300 and 500 mgl^{-1}) had little effect on 1000-seed weight and Seed germination was not influenced by ethrel in *Cucurbita maxima* (Korzeniewska and Niemirowiez, 1993) [5]. Due to the consistent role of ethylene in pumpkin sex expression and considering that flower development is a critical factor influencing plant reproduction and crop yield, the present investigation was aimed to find out the effect of ethylene in increasing the yield potential by sex modification in pumpkin.

Materials and Methods

The present study was carried out at Department of Horticulture, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai during the spring – summer season of 2015 – 2016, under irrigated condition. The crop was grown by adopting the standard package of practices prescribed by the Tamil Nadu Agricultural University (TNAU) Crop production guide, 2013. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with two replications. The different varietal sources *viz.*, CO 1, Pumpkin big, Yellow big, Pennadam local and Melur local were sown with plant to plant spacing of 2 x 2 m by simple hand dibbling method.

According to the treatment structure Ethrel (250 ppm) were sprayed at the 3 to 4 leaf stage and second ethrel spray after 15 days of interval from the first date of spray along with control. The control was a distilled water spray. The consistent stage of ethrel application was done along with control to all the cultivars, thus results 15 consequent treatments. About 25 tones of FYM and recommended dose of fertilizers (50:50:50 kg NPK/ha) were incorporated into soil. The 50 per cent of nitrogen was applied as a basal dose and remaining 50 per cent at 50 days after sowing as a top dress. The entire dose of phosphorous and potassium were applied as a basal dose. The plants were irrigated when required depending on the soil moisture regime. Five plants in each net plot were randomly selected for recording the growth and flower and yield observations and its parameters.

The following characteristics were measured: number of nodes per plant, number sex ratio (female to male) per plant, period from sowing to emergence of the first male flower (in days), period from sowing to the emergence of the first female flower (in days), and number of fruits per plant. Results of the experiment were statistically analyzed (ANOVA) by calculating the means separated by LSD multiple range test at 0.05 level.

Results and Discussion

The effect of ethrel on different cultivars with varied stages of spray and their influence on sex modification along with crop growth parameters were given in Table 1. The female / pistillate flower is bestowed with fruit bearing at the axil end of the flower, whereas the male flower is devoid of fruit bearing capability (Fig. 1 & 2). The number of nodes per plant was recorded highest in T_9 (34.15) followed by T_6 (31.06) and least by T_{13} (11.33). The sex ratio of female to male flower was registered significant in resulted with significant in T_9 (1.68) followed by T_8 (1.24) and least by T_{11} (0.39). These findings are consistent to (Krishnamoorthy, 1981) [6] who studied the effect of ethrel at 250 to 1000 ppm on growth, flowering and sex expression of *Cucurbita pepo* L. Application of exogenous hormones at the appropriate time cause floral primordial destined to become unisexual flowers to be covered to bisexual flowers or completely change of opposite sex (Rudich, 1990) [10]. Application of ethylene have been shown to increase pistillate flower production in cucumber, squash and muskmelon (Augustine *et al.*, 1973) [2]. These results are in confirmity with the findings of (Arora *et al.*, 1985) [1] who have recorded maximum vine length and number of branches with the spray of ethrel at two and four leaf stage compared to control in bottle gourd. Similarly, (Vadigeri *et al.*, 2001) [15] reported that the seedlings of Poinsettee variety of cucumber sprayed with ethrel (400 ppm) at four to six leaf stage significantly increased the number of female flowers per plant and reduced the sex ratio compared to control.

Table 1: Effect of ethrel on growth and yield parameters of pumpkin (*Cucurbita moschata* L.)

TREATMENTS	No. of Nodes / Plant	Sex ratio (Female to Male)	No. of days to staminate flowering	No. of days to pistillate flowering	No. of fruits / plant
T_1 (CO 1+ Control)	17.49 ^{c}	0.24 ^{d}	40.08 ^{b}	43.97 ^{e}	1.79 ^{bc}
T_2 (CO 1+ Ethrel @ 250 ppm)	20.29 ^{b}	1.11 ^{b}	42.06 ^{d}	39.18 ^{a}	1.82 ^{b}
T_3 (CO 1+ Ethrel @ 250 ppm+ Spray after 15th day)	22.47 ^{b}	1.07 ^{b}	43.12 ^{e}	38.54 ^{a}	1.91 ^{a}
T_4 (Pumpkin big+ Control)	15.76 ^{c}	0.31 ^{d}	39.21 ^{a}	42.76 ^{d}	1.66 ^{d}
T_5 (Pumpkin big + Ethrel @ 250 ppm)	28.18 ^{b}	0.74 ^{c}	40.81 ^{b}	40.22 ^{ad}	1.71 ^{c}
T_6 (Pumpkin big + Ethrel @ 250 ppm+ Spray after 15th day)	31.06 ^{a}	0.97 ^{c}	42.98 ^{d}	38.93 ^{a}	1.85 ^{b}
T_7 (Yellow big + Control)	29.10 ^{b}	0.17 ^{d}	40.20 ^{b}	43.26 ^{e}	1.80 ^{b}
T_8 (Yellow big + Ethrel @ 250 ppm)	30.91 ^{a}	1.24 ^{b}	42.57 ^{d}	38.12 ^{a}	1.83 ^{b}
T_9 (Yellow big + Ethrel @ 250 ppm+ Spray after 15th day)	34.15 ^{a}	1.68 ^{a}	43.88 ^{e}	37.61 ^{a}	1.97 ^{a}
T_{10} (Pennadam Local+ Control)	12.57 ^{c}	0.39 ^{d}	39.57 ^{a}	42.01 ^{d}	1.71 ^{c}
T_{11} (Pennadam Local + Ethrel @ 250 ppm)	17.12 ^{c}	0.68 ^{c}	40.46 ^{b}	40.59 ^{b}	1.79 ^{bc}
T_{12} (Pennadam Local + Ethrel @ 250 ppm+ Spray after 15th day)	18.84 ^{c}	0.91 ^{c}	41.95 ^{c}	39.54 ^{a}	1.81 ^{b}
T_{13} (Melur Local+ Control)	11.33 ^{c}	0.49 ^{cd}	39.29 ^{a}	42.10 ^{d}	1.68 ^{d}
T_{14} (Melur Local + Ethrel @ 250 ppm)	13.67 ^{c}	0.52 ^{c}	39.31 ^{a}	41.61 ^{c}	1.71 ^{c}
T_{15} (Melur Local + Ethrel @ 250 ppm+ Spray after 15th day)	14.82 ^{c}	0.84 ^{c}	49.16 ^{c}	39.89 ^{a}	1.78 ^{bc}

Mean with same letter sign in each column has no significant difference in ($p<0.0$)

The number of days to staminate flower emergence from the date of sowing was registered significant in T_{13} (39.21) and the number of days to pistillate flower emergence from the date of sowing was resulted in reduced date in T_9 (37.16). All Ethephon concentrations decreased the sex ratio. These results indicated that Ethephon was more effective in female flower induction and confirmed results of other authors (Thomas, 2008) [14], (Yongan *et al*., 2002) [16], (Kshirasagar *et al*., 1995) [7], (Shanmugavelu *et al.*, 1973) [11]. Different concentrations of Ethephon had similar effects on female flower produced (Vadigeri *et al.*, 2001) [15]. In bitter melon, ethrel was more effective in the percentage of pistillate flowers which formed fruits than GA_3 (Thomas, 2008) [14].

Fig 1: Pistillate/female flower

Fig 2: Staminate / male flower

The total number of fruits per plant was found highest in T_9 (1.97) followed by T_8 (1.83) and least by T_{13} (1.68). These results are in concurrent with (Singh and Singh, 1984) [12] recorded maximum fruit weight, length of fruit, diameter of fruit, number of fruits per vine and fruit yield per vine with the application of ethrel at two and four leaf stage compared to control in cucumber. The application of Ethephon at (100 and 200 mgl^{-1}) in cucumber increased the yield significantly in compared with control (Thappa, 2011) [13]. The fruit yield obtained was higher during summer and this might be due to increased number of female flowers, fruit set and increased metabolic activity leading to higher translocation of metabolites from source to sink (Arora *et al.*, 1988) [1]. Among the different varietal source Yellow big resulted with superior performance in all recorded parameters indicating T_9 as best compare to all other treatments.

Acknowledgement
The author was very much grateful for the support rendered by faculties of Horticulture department and Orchard workers of Agricultural College and Research Institute (AC & RI), Tamil Nadu Agricultural University (TNAU), Madurai, for accomplishing the research activities in a triumphant process.

References

1. Arora SK, Pandita ML, Baswana KS. Effect of growth regulators on flowering and fruiting of bottle gourd. Haryana. Agric. Univ. J Res. 1985; 25:36-41.
2. Augustine JJ, Baker LR, Sell HM. Female flower induction on androecious cucumber, *Cucumis sativus L*. J Amer. Soc. Hort. Sci. 1973; 98:197-199.
3. Domir SC, Foy CL. A study of ethylene and CO2, evolution from Ethephon in tobacco. Pesticide biochemistry and physiology. 1978; 9:1-8.
4. Hossain D, Karim MA, Pramanik MHR, Rahman AAM. Effect of gibberellic acid (GA_3) on flowering and fruit development of bittergourd (*Momordica charantia* L.) International Journal of Botany. 2006; 2:329-332.
5. Korzeniewska A, Niemirowiez SK. Effect of ethrel on fruit and seed related characters in four inbred lines of *Cucurbita maxima* Duch. Gatenbauwissenschaff. 1993; 58:266-271.
6. Krishnamoorthy HN. Plant growth substances. Tata McGraw-Hill Publishing Company Ltd. New Delhi, 1981, 169-175.
7. Kshirasagar DB, Desai UT, Patll BT, Pawer BU. Effect of plant growth regulators on sex expression and fruiting in cucumber cv. Hemangi. Journal of Maharashtra Agricultural Universities. 1995; 20:473-474.
8. Pappaiah CM, Muthuswamy S. Effect of growth regulators on growth, flowering and quality and essential oil content of *Jasminum auriculatum var. Parimullai*. South Indian Horticulture. 1978; 26:66-71.
9. Ram A, Singh GN, Shukla HS, Rajbir S. Effect of seed soaking with Gibberellic acid on growth and fruiting of muskmelon (*Cucumis melo* L.). Haryana J Hort. Sci. 2001; 30:277-278.
10. Rudich J, Halevy AH, Kedar N. Ethylene evolution from cucumber plants related to sex expression. Plant Physiol. 1972; 49:998-999.
11. Shanmugavelu KG, Thamburaj S, Srinivasan C. Effect of ethrel (Ethephon) on pumpkin (*Cucurbita moschata* Poir.). South Indian Horticulture. 1973; 21:94-99.
12. Singh RK, Singh GP. Effect of growth regulators on sex expression, sex ratio and yield in cucumber (*Cucumis sativus* L.). South Indian Horticulture. 1984; 32:127-131.
13. Thappa M, Kumar S, Rafiq R. Influence of Plant Growth Regulators on Morphological, Floral and Yield Traits of Cucumber (*Cucumis sativus* L.). Kasetsart J (Nat. Sci.). 2011; 45:177-188.
14. Thomas TD. The eVect of *in vivo* and *in vitro* applications of ethrel and GA3 on sex expression in bitter melon (*Momordica charantia* L.). Euphytica. 2008; 164:317-323.
15. Vadigeri BG, Madalageri BB, Sheelavantar MN. Effect of ethrel and gibberellic acid on yield and quality of two cucumber varieties. Karnataka J Agric. Sci. 2001; 14:727-730.
16. Yongan C, Bingkui Z, Enhui Z, Zunlian Z. Control of sex expression in summer squash (*Cucurbita pepo* L.). Cucurbit Genetics Cooperative Report. 2002; 25:51-53.