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Interaction of Plant Growth Regulators on Reversal of Reproductive Character in *Sechium Edule* L. Leading to Increased Yield

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Abstract: *A field experiment was conducted to study the effect of interaction of plant growth regulators on reversal of reproductive character in Sechiumedule L. The growth promoter GA_3 was applied to the seedlings at the concentrations of 100, 250, 500 and 1000µg/ml. After 7 days of interval the second compound, the growth retardant ethrelat the concentration of 50, 100, 250 and 1000µg/ml wasµade to the squash seedlings by foliar spraying. The optimal concentration of GA_3 (250µg/ml) in combination with 100µg/ml of ethrelproduced 89.2 number of female flowers against 31.06 number at the control. The same range of GA_3 was applied to the seedlings of squash grown in another plot. After an interval of 7 days, the growth retardant CCC at the concentration of 50, 100, 250 and 1000µg/ml was applied to the seedlings. GA_3 250µg/ml and CCC 250µg/ml was turned out as optimum concentration produced 140.2 numbers of female flowers against 65.53 at control. The experiment confirmed the effect of interaction of PGRs in S.edule L. producedµore female flowers than they produced individually which is reflected in increased yield.*

Keywords: *CCC, Ethrel, GA_3, Sechiumedule L.*

INTRODUCTION

It is now known that sex expression in plants is subject to genetic set up, environmental reaction and chemicalµakeup of the plant. Besides, the genetical set up the factors which readily affect the sex expression are temperature, day length, nutrition, chemicals and plant growth regulators (Heslop-Harrisson 1957, 1963).Manipulation of growth and development of plants for agricultural and horticultural purposes is an absorbing interest to the plant physiologists. The important tools, being used in recent days, for achieving plant types for enhanced productivity of crop plants are some growth promoters and growth retardants (Lama 2000). Growth promoters are types of phytohormones which promote, enhance or accelerate the overall growth, development andµetabolism of plants, while growth retardants are usually the synthetic chemicals which suppress the overall growth andµetabolism of plants by slowing down cell division and cell elongation without altering their grossµorphology (Cathey 1964). Scientists from different parts of the world are now concentrating on application of PGRs to increase yield and quality of agricultural crops. Application of auxin stimulates development of female flowers rather thanµale flowers in some cucurbitaceous plant (Laibach and Kribben, 1959). Robinson *et al* (1970) reported that sex expression in cucumber shifted to femaleness by the application of ethephon. While investigating the effect of growth regulators on sex expression of bitter gourd,Mia *et. al.* (2014) showed that application of CEPA at 150 ppm and NAA at 50 ppm was found to be the best treatments for reducing sex ratio by increasing the female flowers by suppressing theµale ones and consequently induce higher yield.

A work was done on influence of plant growth regulators on flowering, fruit yield and quality of pumpkin by Nagaich *et. al.* (2000). An experiment was conducted on *Cucurbitamoschata* L cv. local selection and plants were sprayed at the 2 true leaf stage and again at the 3-4 leaf stage with 100 or 200 ppm ethrel, NAA orµaleic hydrazide or 25 or 50 ppm gibberellic acid. Fruit yield was highest with

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either concentration of ethrel.Male flowers appeared earliest with 25 ppm gibberellic acid and female flowers with 200 ppm ethrel.

Effect of CCC on fruit set and yield were studied byμany workers. Desai *et al* (1982) recorded higher fruit yield in kaghzi lime with the application of CCC at 1000 ppm. Das and Prasad (2004) studied the effect of plant growth regulators on green gram (*Phaseolusradiatus*). They reported that application of CCC 750 ppm significantly increased the number of branches over the control. Thukral *et. al.* (1993) investigated the effect of growth regulators on regulation of crop and fruit quality in lemon and reported that among all the growth regulators CCC increased the number of flowers per tree and decreased the length of shoot.Baruah and Sarma (2013) reported that the application of ethrel and CCC can reverse the reproductive character in *Sechiumedule* L. which lead to crop improvement.

Sechiumedule L. (squash) is an annual climber belongs to the family cucurbitaceae. The plant bears unisexual flowers but bothμale and female flowers are borne on the same plant. In general, the plant bearsμoreμale flowers than female flowers. The production of fruits depends on number of female flowers the plant bears. Assam, situated in the North Eastern part of India is one of the squash growing area because its agro climatic condition is favourable for cultivation of various plants under cucurbitaceae family. Though this crop is important food item of this region, the average productivity is not enough to fulfil the demand of the people. The reason behind the less production of the crop is the development ofμoreμale flowers than female ones by the plant. Development ofμore female flowersμeansμore production of fruits. The present investigation was carried out to evaluate the combined effects of plant growth promoters (GA_3) and retardants (Ethrel and CCC) on reversal of reproductive characters on *Sechiumedule* L. Emphasis was laid on reducing the number ofμale flowers and at the same time increasing the number of female flowers.

MATERIALS AND METHOD

The experiment was conducted to find out the effect of interaction of PGRs on reversal of reproductive character of squash. Botanically squash is known as *Sechiumedule* L belonging to the family Cucurbitaceae. The soil of the experimental field was sandy loam with pH value 5.10. The soil wasμixed withorganicμanure before sowing of seeds. The site received free sunshine.

The healthy squash fruits were collected from the localμarket of Bongaigaon. The experiment was carried out in two experimental plots with six treatments of PGRs including an untreated control. Each treatment was replicated three times. For interaction of PGRs, the growth promoter GA_3 (Gibberellic acid) at 100μg/ml, 250μg/ml, 500μg/ml and 1000μg/ml were prepared. When the plants were at seedling stage and about 20 days of emergence of the seedlings the concentrations of GA_3 were applied. The growth retardant Ethrel (2-chloroethyl phosphonic acid) was applied at the concentrations namely 50, 100, 250, 1000μg/ml after 7 days of interval. One kept as control (distl. water treatment). Similarly in another experimental plot seedlings of squash were grown and GA_3 at 100μg/ml, 250μg/ml, 500μg/ml and 1000μg/ml were applied and after 7 days the second compound the growth retardant CCC (2-chloroethyl trimethyl ammonium chloride) was alsoμade to seedlings of squash at 50, 100, 250 and 1000μg/ml by foliar spraying of the solutions. The spray was done twice at 30 days after sowing and again after 7 days of first application. The data was recorded on number ofμale and female flowers at the flowering stage.

RESULTS AND DISCUSSION

The interaction between ethrel and GA_3 was carried out on squash to examine the combined effect of the compounds on flowering. GA_3 was applied at the concentrations of 100, 250, 500 and 1000μg/ml, but ethrel was applied at the concentrations of 50, 100, 250 and 1000μg/ml. Counting the number of flowers was done after 50 days. The number ofμale flowers produced was recorded as 77.83, 109.73, 106.96 and 79.16 at 100, 250, 500 and 1000μg/ml concentrations of GA_3 respectively. On the other hand, ethrel producedμale flowers were recorded as 77.76, 86.5, 90.83 and 58.63 at 50, 100, 250 and 1000μg/ml concentrations respectively. Both GA_3 and ethrel at 250μg/ml emerged as optimal concentration (Figure 1). The optimal concentration of GA_3 (250μg/ml) in combination with 50, 100, 250 and 1000μg/ml of ethrel produced 122.73, 138.2, 140.53 and 131.4 number ofμale flowers respectively against 76.06 number at the control (Table 1).

Statistical analysis (Table 2) of the experimental data reveals that both the compounds imparted their

Table 1
Interaction of Ethrel and GA_3 on production ofmale flowers in *S.edule* L. (Mean ofmale flowers for 3 consecutive years)

Ethrel (mg/ml)		*GA_3 Conc. (mg/ml)*			*Mean for Ethrel*	
0	100	250	500	1000		
0	76.06	77.83	109.73	106.96	79.16	89.9
50	77.76	85.1	122.96	110.4	102.73	99.8
100	86.5	87.86	138.2	119.76	107.4	107.9
250	90.83	123.73	140.53	136.06	111.4	120.5
1000	58.63	67.5	131.4	107.06	84.63	89.8
Mean for GA_3	77.9	88.4	128.6	116.0	97.1	

CD for GA_3 (n = 15) at 5% probability level = 2.29, at 1% probability level = 3.00
CD for ethrel (n = 15) at 5% probability level = 2.29, at 1% probability level = 3.00

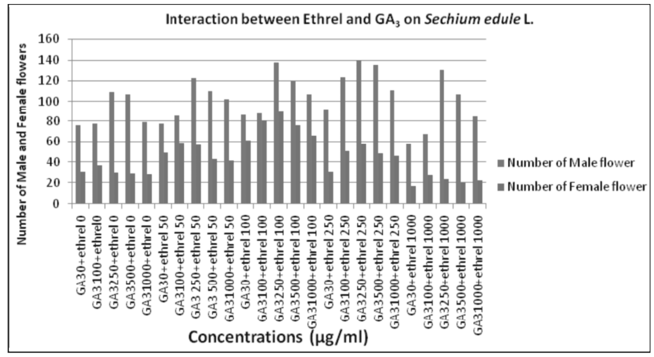

Figure 1: Interaction between Ethrel and GA_3 on Sechiumedule L

Table 2
Analysis of Variance for interaction of ethrel and GA_3 on male flower of *S. edule* L.

Sources of Variance	*Df*	*SS*	*Mean SS*	*Variance ratio (F)*
GA_3	4	25344.42	6336.1	621.2**
Ethrel	4	10128.05	2532.0	248.2**
Interaction (Ethrel×GA_3)	4 × 4 = 16	3323.15	207.7	20.4**
Error	50	510.6	10.2	
Total	75 – 1 = 74	39306.22		

Significant at 1% probability level.

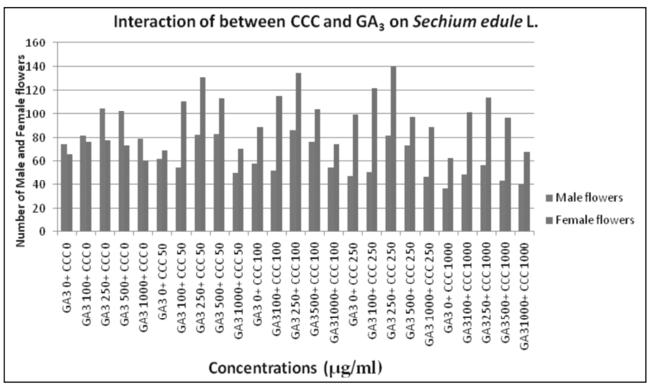

Figure 2: Interaction of between CCC and GA_3 on SechiumeduleL.

highly significant effects. The interaction also emerged as highly significant establishing the observed highly stimulatory combined effect of the compounds on production of flowers.

The interaction between ethrel and GA_3 proved to be highly stimulatory in producing female flowers on squash (Table 3). The number of female flowers was recorded as 36.9, 30.4, 29.3, 28.6 at the concentrations of 100, 250, 500 and 1000µg/ml of GA_3. Ethrel produced female flowers were 49.96, 61.4, 31.3, 16.83 at 50, 100, 250 and 1000µg/ml concentrations respectively. GA_3 250µg/ml and ethrel 100µg/mlturned out to be optimal concentrations. GA_3 250µg/ml produced female flowers in combination with 50, 100 (Optimum), 250 and 1000µg/ml of ethrel were recorded as 57.2, 89.2, 57.96, 24.4 respectively.

Statistical analysis (Table 4) of pooled data shows the effect of ethrel and GA_3 to be highly significant. The interaction also emerged as highly significant establishing their positive effect in producingmore female flowers (Table 5).

The present investigation also reveals the positive effect of CCC and GA_3on production of flowers of squash. GA_3 was applied at the concentrations of 100, 250, 500 and 1000µg/ml and CCC at 50, 100, 250 and 1000µg/ml. The number ofµale flowers was recorded as 81.76, 104.86, 102.86, 102.73 and 79.4 at 100, 250, 500 and 1000µg/ml of GA_3, while CCC at the concentrations of 50, 100, 250 and 1000µg/ml produced 61.63, 57.96, 47.63 and 36.96 numbers ofµale flowersrespectively (Table 6). GA_3 treated plants producedµoreµale flowers than CCC applied plants. Both the compounds in combination producedµore flowers than they produced individually. GA_3 250µg/ml was optimal concentration which producedµore number ofµale flowers which was recorded as 82.3, 86.3, 81.73 and 56.86 in combination with 50, 100, 250 and 1000µg/ml of CCC concentrations. CCC at 50µg/ml was optimal concentration for producingµale flowers on squash.

Statistical analysis (Table 7) reveals that both GA_3 and CCC effects as well as their interactions were highly significant.

The response of squash to CCC and GA_3 wasµore pronounced on production of female flowers thanµale flowers. GA_3 produced female flowers were recorded as 76.96, 77.86, 73.86 and 60.6 at 100, 250,

Table 3
Interaction of Ethrel and GA_3 on production of female flowers in *S. edule* L. (Mean of female flowers for 3 consecutive years)

Ethrel (mg/ml)	*GA_3 Conc. (mg/ml)*					*Mean for Ethrel*
	0	100	250	500	1000	
0	31.06	36.9	30.4	29.3	28.6	31.3
50	49.96	59.0	57.2	43.3	41.63	50.2
100	61.4	80.9	89.27	6.43	66.3	74.8
250	31.3	50.9	57.96	48.96	46.4	47.1
1000	16.83	27.73	24.4	20.4	22.2	22.3
Mean for GA_3	38.1	51.1	51.8	43.7	41.0	

CD for GA_3 ($n = 15$) at 5% probability level = 1.51, at 1% probability level = 1.99
CD for ethrel ($n = 15$) at 5% probability level = 1.51, at 1% probability level = 1.99

Table 4
Analysis of Variance for interaction of ethrel and GA_3 on female flower of *S. edule* L.

Sources of Variance	*Df*	*SS*	*Mean SS*	*Variance ratio (F)*
GA_3	4	2230.1	557.5	123.9**
Ethrel	4	24390.4	6097.6	1355**
Interaction (Ethrel × GA_3)	4 × 4 = 16	1495.5	93.5	20.8**
Error	50	223.5	4.5	
Total	75 – 1 = 74	28339.5		

Significant at 1% probability level.

Plate I: Interaction of GA_3 250µg/ml and CCC 250µg/ml (Optimum) on production of fruits

Plate II: Interaction of GA_3 250µg/ml and Ethrel 100µg/ml (Optimum) on production of fruits in S. edule L.

Table 5
Interactions between ethrel and GA_3 on *Sechiumedule* L.

Serial No.	*Concentration*	*Male flower*	*Female flower*	*Male : female*
1.	GA_3 0 + ethrel 0	76.06	31.06	2.45:1
2.	GA_3 100 + ethrel 0	77.83	36.9	2.11:1
3.	GA_3 250 + ethrel 0	109.73	30.4	3.61:1
4.	GA_3 500 + ethrel 0	106.96	29.3	3.65:1
5.	GA_3 1000 + ethrel 0	79.16	28.6	2.77:1
6.	GA_3 0 + ethrel 50	77.76	49.96	1.56:1
7.	GA_3 100 + ethrel 50	85.1	59.0	1.44:1
8.	GA_3 250 + ethrel 50	122.96	57.2	2.15:1
9.	GA_3 500 + ethrel 50	110.4	43.3	2.55:1
10.	GA_3 1000 + ethrel 50	102.73	41.63	2.47:1
11.	GA_3 0 + ethrel 100	86.5	61.4	1.41:1
12.	$GA_3$100 + ethrel 100	87.86	80.9	1.09:1
13.	$GA_3$250 + ethrel 100	138.2	89.2	1.55:1
14.	$GA_3$500+ethrel 100	119.76	76.43	1.57:1
15.	$GA_3$1000 + ethrel 100	107.4	66.3	1.62:1
16.	$GA_3$0 + ethrel 250	90.83	31.3	2.90:1
17.	$GA_3$100 + ethrel 250	123.73	50.9	2.43:1
18.	$GA_3$250 + ethrel 250	140.53	57.96	2.42:1
19.	$GA_3$500 + ethrel 250	136.06	48.96	2.78:1
20.	$GA_3$1000 + ethrel 250	111.4	46.4	2.40:1
21.	$GA_3$0 + ethrel 1000	58.63	16.83	3.48:1
22.	$GA_3$100 + ethrel 1000	67.5	27.73	2.43:1
23.	$GA_3$250 + ethrel 1000	131.4	24.4	5.39:1
24.	$GA_3$500 + ethrel 1000	107.06	20.4	5.25:1
25.	$GA_3$1000 + ethrel 1000	84.6	22.2	3.81:1

500 and 1000µg/ml respectively. On the other hand CCC produced female flowers were in the order of 69.2, 89.06, 99.1, 62.86 at 50, 100, 250 and 1000µg/ml (Table 8). Both the compound at 250µg/ml turned out to be optimal concentration (Figure2). GA_3 at 250µg/ml produced female flowers in combination with CCC at 50, 100, 250, 1000µg/ml were recorded as 131.16, 134.76, 140.2 and 114.2 respectively.More

Table 6
Interaction of CCC and GA_3 on production ofmale flowers in *S. edule* L. (Mean ofmale flowers for 3 consecutive years)

CCC (mg/ml)		*GA_3 Conc. (mg/ml)*			*Mean for CCC*	
0	100	250	500	1000		
0	74.86	81.76	104.86	102.73	79.4	88.7
50	61.63	54.96	82.3	83.2	50.1	66.4
100	57.96	52.4	86.3	77.06	54.73	65.7
250	47.63	50.76	81.73	73.86	47.0	60.2
1000	36.96	49.2	56.86	43.53	40.3	45.4
Mean for GA_3	55.8	57.8	82.4	76.1	54.3	

CD for GA_3 (*n* = 15) at 5% probability level = 1.57, at 1% probability level = 2.06
CD for CCC (*n* = 15) at 5% probability level = 1.57, at 1% probability level = 2.06

Table 7
Analysis of Variance for interaction of CCC and GA_3 on male flower of *S. edule* L.

Sources of Variance	*Df*	*SS*	*Mean SS*	*Variance ratio (F)*
GA_3	4	10138.1	2534.5	528.02**
CCC	4	14600.1	3650.02	760.4**
Interaction (CCC × GA_3)	4 × 4 = 16	1763.1	110.2	22.9**
Error	50	241.3	4.8	
Total	75 – 1 = 74	26742.59		

Significant at 1% probability level.

number of female flowers was produced by the combined effect of CCC and GA_3 than they produced individually. Statistical analysis (Table 9) proves that the effects of both the compounds as well as their interaction were highly significant. TheMale:female ratio (Table 10)at the respective concentration shows positive impact of the interaction of the PGRs.

The influence of GA_3 on conversion of reproductive character with respect to *S.edule* L studied carefully. The statistical analysis of the experimental dataμakes it clear that GA_3 imparts a positive response in this crop. The interaction between $GA_3$and ethrel and GA_3 and CCC displayed a result with increased number of female flowers (Plate I, II, III, IV, V). The interaction between GA_3 250 and ethrel 100μg/ml producedμaximum number of female flowers recording it as 89.2. On the other hand GA_3 250μg/ml and CCC 250μg/ml produced maximum female flowers recorded as 140.2. The combined effect of GA_3 and ethrel, GA_3 and CCC can be considered beneficial for squash. This finding is in conformity with the findings of Ao (1996) and Barkataki (2002) who confirmed enhanced flowering

Plate III: S. edule L. at flowering stage (Control)

in Kew and Queen varieties of pineapple by the application of GA_3 and ethrel. The results of this present experiment is also in conformity with the findings of Baruahand Sarma (2015) who recommended that the combined effect of ethrel and GA_3, CCC and GA_3 on cucumber is highly significant.

Table 8
Interaction of CCC and GA_3 on production of female flowers in *S. edule* L. (Mean of female flowers for 3 consecutive years)

Ethrel (mg/ml)		*GA_3 Conc. (mg/ml)*			*Mean for CCC*	
0	100	250	500	1000		
0	65.53	76.96	77.86	73.86	60.6	70.9
50	69.2	110.86	131.16	113.66	70.1	98.9
100	89.06	115.53	134.76	104.63	74.73	103.7
250	99.1	121.83	140.2	97.63	88.86	109.5
1000	62.86	101.16	114.2	96.93	67.43	88.5
Mean for GA_3	77.2	105.3	119.6	97.3	72.3	

CD for GA_3(*n* = 15) at 5% probability level = 1.45, at 1% probability level = 1.90
CD for CCC (*n* = 15) at 5% probability level = 1.45, at 1% probability level = 1.90

Table 9
Analysis of Variance for interaction of CCC and GA_3 on female flower of *S. edule* L.

Sources of Variance	*Df*	*SS*	*Mean SS*	*Variance ratio (F)*
GA_3	4	23211.9	5802.9	1415.3**
CCC	4	13824.6	3456.2	842.9**
Interaction (CCC × GA_3)	4 × 4 = 16	4578.8	286.2	69.8**
Error	50	203.6	4.1	
Total	75 – 1 = 74	41818.9		

Significant at 1% probability level.

Plate IV: S. edule L. at fruiting stage (Control).

Sex expression in plants is related to increased nitrogen content of the plant and it can beμodified towards femaleness with increased nitrogen uptake (Minina 1938; Ito and Kato 1953; Brantley and Warren 1960). It was reported by Gopalakrishnan (1965) that nitrogen increases in plants with plant growth regulators spray. That the high level of calcium producesμore female flowers were reported by Waters and Nettles (1961) and Gopalkrishnan (1965). Sigh and Choudhury (1976) confirmed that GA_3 10 ppm sprayed at two and four leaf stage significantly increased the percentage of calcium which ultimately increased the production of female flowers and thereby yield in cucumber. Davis (1987) suggested that exogenous application of plant growth regulators can alter the sex ratio and sequence, if applied at 2 or 4 leaf stage, the critical stage at which the suppression or promotion of either sex is possible. Hence, modification of sex to desired direction has to bemanipulated by exogenous application of plant growth regulators once, twice or even thrice, at different intervals.

Pandey and Singh (1976) proposed that combined application of N and MH producedmore female flowers and the greater in yield in bottle gourd. Ghosh and Basu (1983) conducted an experiment to study the effect of plant growth regulators on sex expression in *Momordicacharantia* L. by the application of GA_3, IAA and 3-hydroxymethyloxindole (HMO). They recommended that all that plant growth regulators stimulated female flowering. Both IAA and HMO accelerated ethylene evolution in the seedlings of *M. charantia* L. while a low concentration of ethrel promoted flowering. Growth regulators or phytohormones, especially ethrel (Papudopoulon*et al* 2005, Manzano *et. al.* 2008) and Giberellic acid *i.e.* GA_3 (Thomas 2008) aremostly used tomodify sex expression inmelon. A number of investigations have revealed that phytohormones are involved in changes

Table 10
Interactions between CCC and GA_3 on *Sechiumedule* L.

Serial No.	*Concentration*	*Male flower*	*Female flower*	*Male : female*
1.	GA_3 0 + CCC 0	74.86	65.53	1.41:1
2.	GA_3 100 + CCC 0	81.76	76.96	1.06:1
3.	GA_3 250 + CCC 0	104.86	77.86	1.35:1
4.	GA_3 500 + CCC 0	102.73	73.86	1.39:1
5.	GA_3 1000 + CCC 0	79.4	60.6	1.31:1
6.	GA_3 0 + CCC 50	61.63	69.2	0.89:1
7.	GA_3 100 + CCC 50	54.96	110.86	0.50:1
8.	GA_3 250 + CCC 50	82.3	131.16	0.63:1
9.	GA_3 500 + CCC 50	83.2	113.66	0.73:1
10.	GA_3 1000 + CCC 50	50.1	70.1	0.71:1
11.	GA_3 0 + CCC 100	57.96	89.06	0.65:1
12.	$GA_3$100 + CCC 100	52.4	115.53	0.45:1
13.	$GA_3$250 + CCC 100	86.3	134.76	0.64:1
14.	$GA_3$500 + CCC 100	77.06	104.63	0.74:1
15.	$GA_3$1000 + CCC 100	54.73	74.73	0.73:1
16.	$GA_3$0 + CCC 250	47.63	99.1	0.48:1
17.	$GA_3$100 + CCC 250	50.76	121.83	0.42:1
18.	$GA_3$250 + CCC 250	81.73	140.2	0.58:1
19.	$GA_3$500 + CCC 250	73.86	97.63	0.76:1
20.	$GA_3$1000 + CCC 250	47.0	88.86	0.53:1
21.	$GA_3$0 +CCC 1000	36.96	62.86	0.59:1
22.	$GA_3$100 + CCC 1000	49.2	101.16	0.49:1
23.	$GA_3$250 + CCC 1000	56.86	114.2	0.50:1
24.	$GA_3$500 + CCC 1000	43.53	96.93	0.45:1
25.	$GA_3$1000 + CCC 1000	40.3	67.43	0.60:1

of flower type, number and ratio of flowers of different sex types,modification of flowering time and of other traits related to sex expression (Noguera *et. al*, 2005; Papadopoulou *et. al.* 2005, Yamasaki *et. al.* 2005, Ouzounidou *et. al.* 2008, Martin *et. al.* 2009). Most of these studies were carried outin cucumber, themodel plant for studying sex expression in cucurbitaceae. However,most of these investigations were focussed only on one or few traits and by using specificphy to hormones. The present investigation confirmed that, the effect of interaction of ethrel and

Plate V: A part of the Experimental plot.

GA_3, CCC and GA_3 is significant in producing maximum female flowers in squash which is reflected in increased yield.

CONCLUSION

In the present study interaction between growth promoter and growth retardant was carried to evaluate their effect on reversal of reproductive character in squash. The combined effect of ethrel and GA_3 proved to be highly effective in generating femaleness on *S.edule* L. GA_3 250mg/ml and ethrel 100mg/ml turned out as optimal concentration for producing maximum number of female flowers (89.2) against 31.06 at control. However, the number of male flowers wasmore at the same combination recording 138.2 against 76.06 at the control. But the female flowers were almost three times higher than the control. Similarly, the combined effect of CCC and GA_3 wasmore pronounced in increasing the femaleness on *S. edule* L. than they produced individually. GA_3 at 250mg/ml in combination with 250mg/ml CCC produced 140.2 number of female flowers against 65.53 at the control. But the number ofmale flowers at all combinations was significantly lower than the numbers produced by GA_3 alone. These findings establishes the fact thatby the combined effect of PGRs the productivity of *S.edule* L. can be increasedto such an extent which would fulfil the needs of the farmers and people as well.

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