EFFECT OF ETHYLENE ON FEMALE FLOWERS, FRUIT YIELD AND FRUIT QUALITY OF *TRICHOSANTHES CUCUMERINA* L.

Khin Thet Oo*

Abstract

The experiment was conducted at the field of VFRDC (Vegetable and Fruit Research and Development Center) Yemon, Hlegu Township, Yangon Region from June 2018 to September 2018. The Key point of the experiment was the effect of ethylene treatments on female flowers emergence and the fruit production of *Trichosanthes cucumerina* L. (Bon-Lon) plants. The experiment was set up in a randomized complete block design (RCBD) with three treatments (1.5ml, 1.0ml, 0.5ml) and each replicated by four. The control plants received none of ethylene treatments. In the experiment, ethylene solutions were sprayed to the plants in alternate weeks, before flower bud emergence. The ethylene solutions applied two times during the life cycle. The statistical results showed that the plant height of ethylene treated plants were reduced than control plants and also the stem girth, number of nodes, internode length, leaf length and leaf width as well. However, the reverse effect of ethylene was observed in the female flower emergence and the fruit yield. Among treatments, T2 (1.0ml) treated plant had higher female flowers and fruit yield. Regarding to the fruit quality, the most sweetness fruit were obtained from T2 (1.0ml). The experiment showed that T2 (1.0ml) ethylene was the proper dosage for female flower, fruit quality and fruit production in Bon-Lon plants.

Keywords: Effect of Ethylene on female flower emergence and the fruit production of Bon-Lon (various concentrations of ethylene 0.5ml, 1.0ml, 1.5ml)

Introduction

Trichosanthes cucumerina L. (Bon-Lon) is the largest genus of the family Cucurbitaceae. It's commonly called as snake gourd, viper gourd, snake tomato or long tomato. Snake gourd are native to southeast Asia, including India, Myanmar, Indonesia, Sri lanka and neighbouring countries (Website. 1). The fruit is a good source of vitamin A, B and C. It is very rich fiber to keep digestive system it will be useful for aiding constipation. It is used in the treatment of headache, fever, malaria, laxative, bronchitis, diarrhoea and skin allergy (Website. 2). January and July are the best time for snake gourd cultivation. Snake gourd grows very well in hot and warm climate (Website No.3). Ethylene can be naturally produced by any part of a plant, but can also be stimulate from other plant hormones such as auxins, gibberellins, abscisic acid and cytokinins (Yang 1969, Woeste *et al*., 1999). Ethylene can promote flowering, inhibit flowering or change the sex expression of monoecious plants such as Cucurbits (Abeles, 1971). Ethylene is also used to promote female sex expression in Cucumber, to prevent self-polination and in increase yield and to inhibit terminal growth of some plant in order to promote lateral growth and compact flowering stem (Yang, 1969). Ethylene changes sex expression also in unisexual plants, increase female flowers in several members of Cucurbitaceae. It also induces male sterility in cucurbits and wheat (Srivastava, 2012). Ethylene has been used in this liquid form to effect seed germination and bulb sprouting, to retard growth, to induce, promote or delay flowering, to alter sex expression in cucumber. (Abeles *et al*., 1971 and Saltveit, 1998). In general, the number of male flowers is produced more than the female flowers in Cucurbits (Website No.4). Ethylene is a gaseous hormone produced naturally by plants. However, the amount is low. The consequence, fruit production is low (Website No.4). The application of ethylene to seedlings would dramatically change the ratio of the female flowers in members of Cucurbitaceae. Ethylene inhibits linear growth of stem, increases diameter and the number of female flowers (Verma, 2003). The present

* Lecturer, Department of Botany, East Yangon University

study aimed at generally to compare the effect of different applications of ethylene on vegetative growth, female flowers and fruit yield of Bon-Lon plants.

Materials and Methods

Botanical studies: Plant identification was done by the references such as The Flora of British India (1879), Taxonomy of Vascular Plants (1951), The Classification of Flowering Plants (1952), List of Trees, Shrubs, Herbs and Principal Climbers etc. (1961), Flora of Java Vol. I (1963), The genera of Flowering Plants Vol. II (1967). Flora of Ceylon; Vol. XI (1997).

Source of plant materials and seed germination: The seeds of *Trichosanthes* (Bon-Lon) were collected from VFRDC. Full cheek and vigorous seeds were selected for seed germination. The seeds were soaked in pure water for 4 hours.

Transplanting of seedlings: When the seedlings possessed 2-true leaves were transplanted to prepare the experimental field.

Soil preparation for cultivation: The cultivation field was thoroughly crushed and removed stones, hard soil balls and garbage. The soil was mixed with cow dung (12.5kg/bed) as basal fertilizer.

Preparation of ethylene solutions: The different concentrations of liquid ethylene 1.5ml, 1.0ml, 0.5ml were used in this experiment. Each concentration of ethylene solution was diluted in 1000 ml of distilled water.

Experimental layout: Randomized completely block design (RCBD) with four replicates were used in this experiment. There were four treatments of ethylene solution as control, 1.5 ml, 1.0 ml, 0.5 ml.

Ethylene treatment: When the plants become 30cm height, the plants were sprayed with various concentrations of ethylene by using hand spray. Ethylene solutions were sprayed to the plants, before flower bud emergence in alternate weeks, applied two times during the life cycle.

Fertilizer application: 15 days after cultivation, the compound fertilizer NPK (15:15:15) were applied as 10g / plants.

Weeding: Weeding was done every week by manually.

Pets and Disease control: The fungicide (sinagi), co-oxide and pesticides (neem) were sprayed to the plants when it was necessary.

Data collection and statistical analysis: The data for horticultural characters such as plant height, number of lateral branches, number of male and female flowers, number of fruit/plant and etc. were collected. The single fruit quality such as fruit weight, fruit length, fruit width, flesh thickness, sweetness and acidity were also collected. All record data were statistically analyzed using CROPSTAT software.

Results

The statistically analyzed result of the plant height, stem girth, number of node/plant, inter node length, number of leaf/plant, petiole length, petiole girth, leaf width, leaf length, number of branch were shown in the following figures (1 to 10) and tables (1 to 10). Moreover, the single

fruit characters, mean value of yield and yield components, number of male and female flowers/plant shown in table (11 to 14) and figure (11 to 13).

Table 1 Effect of ethylene solution on plant height in *Trichosanthes cucumerina*

Treatment	Plant height (cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	34.46	41.95	44.57	46.25	49.95	73.50	108.72	57.06
T 2(1.0 ml)	45.63	54.70	67.20	73.90	76.42	106.07	133.33	79.61
T 3(0.5 ml)	42.44	54.55	73.30	76.05	78.95	135.05	155.50	87.98
T4 (control)	54.27	79.30	93.55	111.00	122.20	145.95	164.37	110.09
F-test	ns	*	ns	*	**	**	ns	-
5 % LSD	13.8	22.25	37.9	39.18	35.15	37.5	46.5	-
cv %	19.6	24.1	34.1	31.9	26.8	20.4	20.7	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

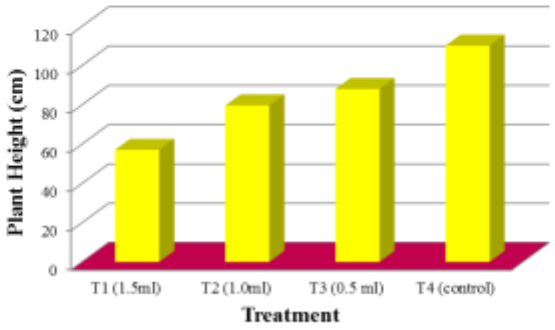

Figure 1 Different doses of ethylene solution on the plant height in *Trichosanthes cucumerina*

Table 2 Effect of ethylene solution on the stem girth in *Trichosanthes cucumerina*

Treatment	Stem girth (cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	3.75	4.13	4.90	5.42	5.60	5.72	5.97	5.07
T 2(1.0 ml)	3.05	3.80	5.07	5.60	5.95	6.15	5.80	5.06
T 3(0.5 ml)	3.40	3.70	5.27	5.65	5.77	5.97	6.17	5.13
T4 (control)	3.45	4.90	5.05	5.32	5.57	6.05	6.40	5.25
F-test	ns	ns	ns	ns	ns	ns	ns	-
5 % LSD	1	0.88	0.66	0.76	0.85	0.86	1.21	-
cv %	18.4	13.4	8.2	8.7	9.3	9.1	12.4	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

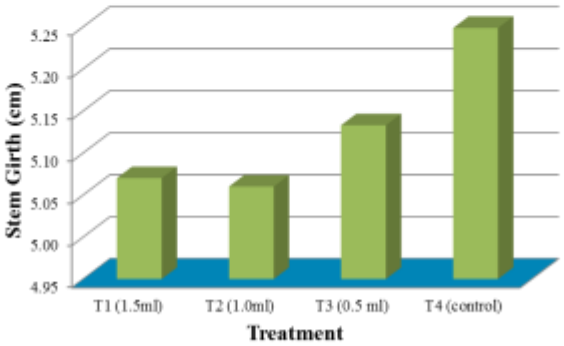

Figure 2 Different doses of ethylene solution on the stem girth in *Trichosanthes cucumerina*

Table 3 Effect of ethylene solution on the number of node/ plant in *Trichosanthes cucumerina*

Treatment	Number of node/ Plant							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	6.90	7.45	7.60	8.00	8.62	10.95	14.67	9.17
T 2(1.0 ml)	8.20	8.75	9.60	10.15	10.90	12.01	19.27	11.27
T 3(0.5 ml)	8.30	8.60	9.80	10.70	10.90	15.25	20.75	12.04
T4 (control)	8.70	11.20	12.45	14.40	15.00	18.50	26.50	15.25
F-test	ns	**	*	*	*	*	**	-
5 % LSD	1.96	1.87	2.91	3.27	3.30	4.96	5.44	-
cv %	15.3	13.0	18.5	18.9	18.2	21.9	16.8	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

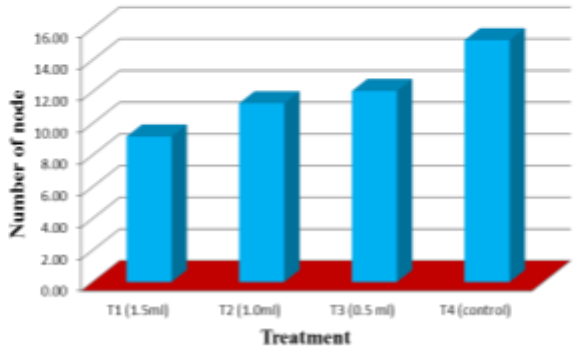

Figure 3 Different doses of ethylene solution on the number of node / plant in *Trichosanthes cucumerina*

Table 4 Effect of ethylene solution on internode length in *Trichosanthes cucumerina*

Treatment	Internode length (cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	4.27	4.55	5.64	5.85	6.16	5.52	8.75	5.82
T 2(1.0 ml)	4.80	5.27	6.23	6.56	7.01	7.60	8.20	6.52
T 3(0.5 ml)	5.52	5.85	6.68	7.60	8.20	8.65	12.62	7.87
T4 (control)	6.27	6.91	7.73	8.45	9.80	10.05	10.75	8.57
F-test	ns	*	ns	*	**	**	ns	-
5 % LSD	1.96	1.6	1.7	1.47	1.64	1.78	4.8	-
cv %	18.3	17.8	16.2	12.9	13.2	13.6	30	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

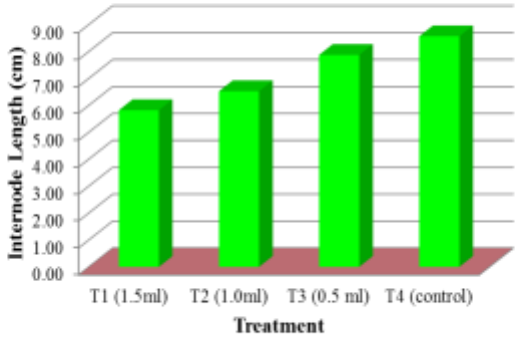

Figure 4 Different doses of ethylene solution on the internode length in *Trichosanthes cucumerina*

Table 5 Effect of ethylene solution on the number of leaf/ plant in *Trichosanthes cucumerina*

Treatment	Number of leaf /plant							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	5.05	5.35	6.43	7.50	8.75	10.35	12.37	7.97
T 2(1.0 ml)	5.75	6.85	10.45	11.75	12.70	17.05	21.67	12.32
T 3(0.5 ml)	6.35	7.25	8.35	10.25	11.95	19.10	22.90	12.31
T4 (control)	6.85	8.05	8.35	9.70	10.70	17.80	24.10	12.22
F-test	ns	ns	ns	ns	ns	ns	*	-
5 % LSD	1.57	2.39	4.58	5.12	5.30	6.89	7.38	-
cv %	16.4	21.8	34.1	32.7	30	26.8	22.8	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

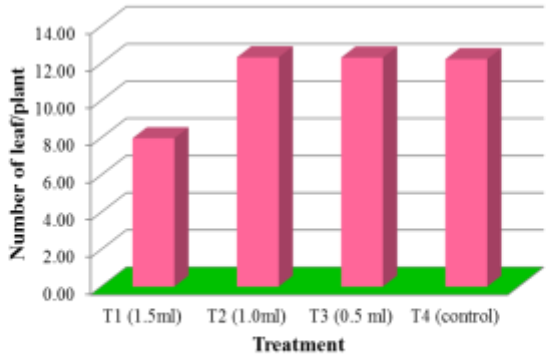

Figure 5 Different doses of ethylene solution on the number of Leaf /plant in *Trichosanthes cucumerina*

Table 6 Effect of ethylene solution on petiole length in *Trichosanthes cucumerina*

Treatment	Petiole length(cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	4.00	4.30	4.73	5.65	6.46	6.87	7.40	5.63
T 2(1.0 ml)	4.16	5.77	6.31	6.83	7.57	8.03	8.52	6.74
T 3(0.5 ml)	5.10	6.00	6.89	7.34	7.07	8.32	9.37	7.16
T4 (control)	3.52	4.94	5.38	5.95	6.46	7.26	8.75	6.04
F-test	ns	ns	*	**	ns	*	ns	-
5 % LSD	1.94	1.66	1.46	0.79	1.22	1.02	1.9	-
cv %	29	19.9	15.8	7.7	10.9	8.4	14	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

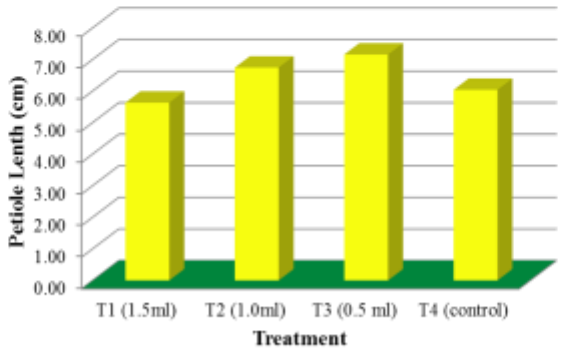

Figure 6 Different doses of ethylene solution on the petiole length in *Trichosanthes cucumerina*

Table 7 Effect of ethylene solution on the petiole girth in *Trichosanthes cucumerina*

Treatment	Petiole girth(cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	2.00	2.27	2.47	2.67	2.75	3.02	3.22	2.63
T 2(1.0 ml)	1.72	2.45	2.80	2.92	3.17	3.37	3.68	2.87
T 3(0.5 ml)	1.97	2.25	2.77	2.95	3.12	3.55	3.70	2.90
T4 (control)	2.25	2.62	3.00	3.50	3.70	3.83	4.06	3.28
F-test	*	*	*	*	*	*	ns	-
5 % LSD	0.33	0.26	0.28	0.52	0.52	0.51	0.63	-
cv %	10.5	6.9	6.4	11	10.3	9.4	10.8	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

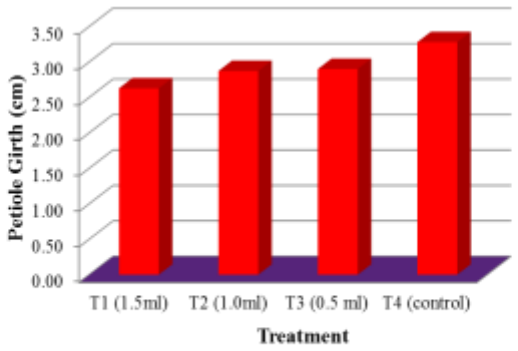

Figure 7 Different doses of ethylene solution on the petiole girth in *Trichosanthes cucumerina*

Table 8 Effect of ethylene solution on the leaf length in *Trichosanthes cucumerina*

Treatment	Leaf length (cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	3.43	3.94	4.50	5.29	5.62	5.95	6.73	5.07
T 2(1.0 ml)	4.40	4.85	5.48	5.97	6.53	7.01	8.15	6.06
T 3(0.5 ml)	5.26	5.63	6.00	6.26	6.67	7.03	8.84	6.53
T4 (control)	5.15	6.05	7.33	7.47	7.91	8.31	8.80	7.29
F-test	*	*	**	**	*	**	ns	-
5 % LSD	1.05	1.32	0.91	0.88	1.34	1.15	2.4	-
cv %	14.5	16.2	9.9	8.9	12.5	10.2	18.5	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

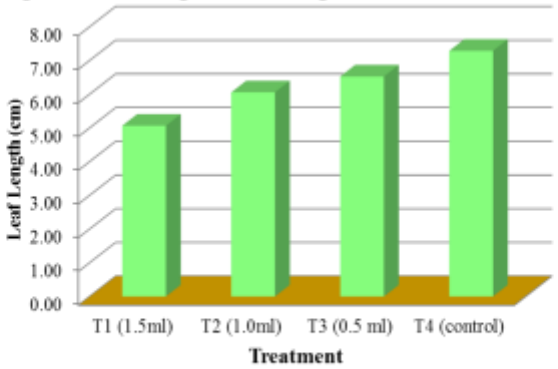

Figure 8 Different doses of ethylene solution on the leaf length in *Trichosanthes cucumerina*

Table 9 Effect of ethylene solution on Leaf width in *Trichosanthes cucumerina*

Treatment	Leaf width (cm)							
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	Mean
T 1(1.5 ml)	4.51	5.52	5.61	6.31	6.60	7.73	8.42	6.39
T 2(1.0 ml)	6.24	6.59	7.36	7.64	7.79	9.37	11.43	8.06
T 3(0.5 ml)	7.08	7.23	7.32	7.59	8.11	9.90	10.75	8.28
T4 (control)	7.30	7.86	8.99	9.38	10.01	11.17	11.30	9.43
F-test	*	*	**	**	**	**	*	-
5 % LSD	1.64	1.5	1.45	1.44	1.16	1.56	2.07	-
cv %	16.4	13.8	12.4	11.7	8.9	10.2	12.4	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

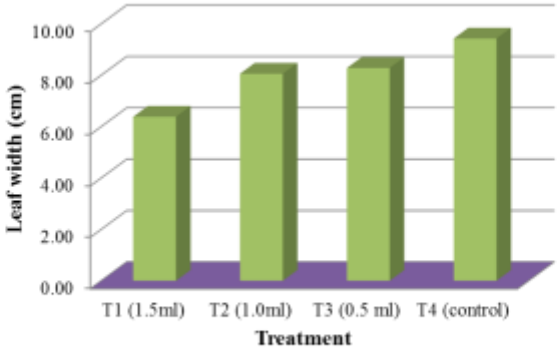

Figure 9 Different doses of ethylene solution on leaf width in *Trichosanthes cucumerina*

Table 10 Effect of ethylene solution on the number of branches /plant

Treatment	Number of branches /plant						
	18 DAS	25 DAS	32 DAS	39 DAS	46 DAS	53 DAS	Mean
T 1(1.5 ml)	0.75	0.87	0.95	1.22	1.47	1.95	0.75
T 2(1.0 ml)	1.25	1.55	1.65	1.90	2.15	2.35	1.25
T 3(0.5 ml)	1.20	1.40	1.65	2.05	2.25	2.55	1.20
T4 (control)	0.80	0.90	0.95	1.25	1.40	1.50	0.80
F-test	ns	ns	ns	ns	ns	ns	-
5 % LSD	0.69	0.77	0.8	0.85	1.03	1.37	-
cv %	43.5	41.0	38.5	33.4	35.6	41.1	-

DAS = days after sowing, ns = non significant *significant P<0.05 **highly significant <0.01

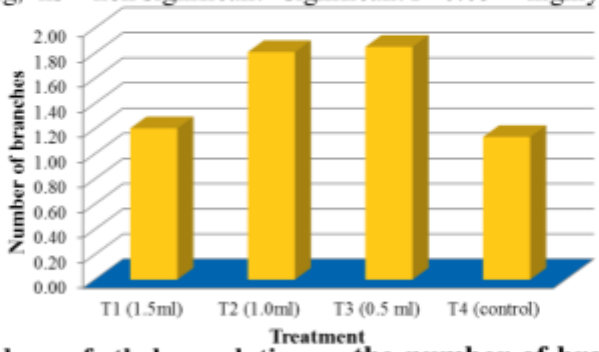

Figure 10 Different doses of ethylene solution on the number of branches /plant in *Trichosnathes cucumerina*

Table 11 A single fruit characters in *Trichosanthes* from different ethylene treatments

Treatment	Fruit length(cm)	Fruit width(cm)	Flesh Thickness(mm)	Sweetness(%)	Acidity(%)
T1 (1.5ml)	56.56	23.43	3.75	3.81	1.68
T2 (1.0ml)	56.87	27.25	4.87	4.37	1.36
T3 (0.5ml)	60.37	33.50	5.37	3.37	1.40
T4 (control)	59.50	29.45	5.12	3.05	1.15
F-test	ns	ns	ns	ns	ns
5 % LSD	21.46	8.45	1.47	1.80	0.65
cv %	23.0	18.6	19.3	30.9	29.4

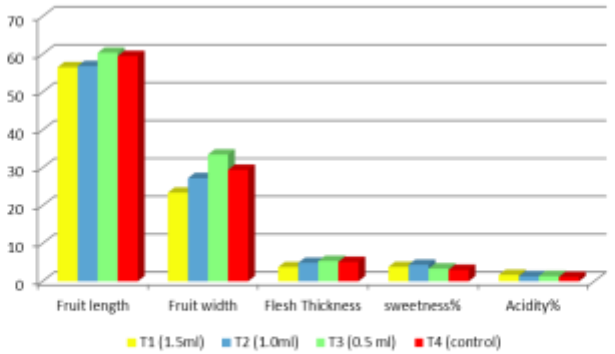

Figure 11 A single fruit characters in *Trichosanthes* from different ethylene treatments

Table 12 Number of fruit/plants and seed/fruit of *Trichosanthes cucumerina* L.

Treatment	Number of fruit/plants	Number of seed/fruit
T1 (1.5ml)	1.5	13
T2 (1.0ml)	3.5	18
T3 (0.5 ml)	2.25	13.5
T4 (control)	2.75	18.5
F-test	ns	ns
5 % LSD	1.92	12.65
cv %	48.1	50.2

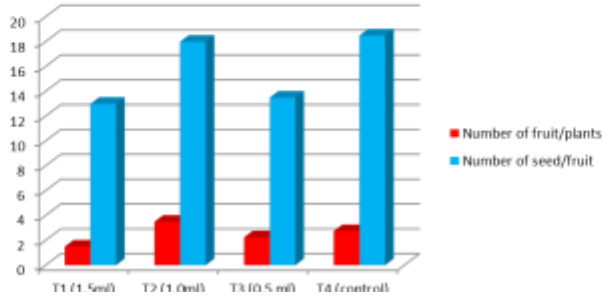

Figure 12 Number of fruit/plants and seed/fruit of *Trichosanthes cucumerina* L.

Table 13 Mean values of Yield components of *Trichosanthes cucumerina* L.

Treatment	Fruit weight(g)	Total seed weight(g)	10,seed weight(g)
T1 (1.5ml)	129.13	4.67	3.47
T2 (1.0ml)	175.87	6.12	3.37
T3 (0.5 ml)	273.17	4.57	3.45
T4 (control)	197.02	3.95	2.25
F-test	ns	ns	*
5 % LSD	132.76	3.75	1
cv %	42.8	48.6	20.1

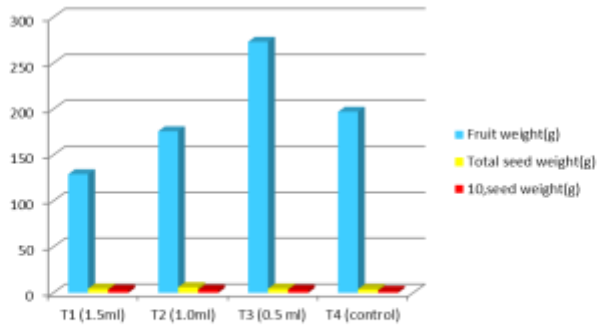

Figure 13 Mean values of Yield components of *Trichosanthes cucumerina* L.

Table 14. Effect of ethylene solution on the number of male and female flower/plant in *Trichosanthes cucumerina*

Treatment	Number of male flower/plant	Number of female flower/plant
T1 (1.5ml)	7.0	4.8
T2 (1.0ml)	5.8	10.0
T3 (0.5 ml)	4.0	4.4
T4 (control)	55.4	7.4

Discussion and Conclusion

In this study, three treatments of ethylene were tested on *Trichosanthes cucumerina* (Bon-Lon) plants in order to determine their effects on female flowers, fruit yield and fruit quality. The control plants did not receive any treatments except regular watering. The result showed that the control plant (T4) were increased in plant height, internode length, stem girth, number of node/plant, petiole girth, leaf length and width than the treatments of ethylene solution. This observation was in agreement with Pratt *et al*., (1969) who mentioned that ethylene is a natural growth regulator has been implicated in several developmental processes of plants. Moreover, Verma (2003) agreed that ethylene inhibited linear stem growth but increased in stem diameter and number of female flower. Saltveit (1998) mentioned that ethylene has been used in this liquid form to effect seed germination and bulb sprouting, to retard growth. The present study examined plant height, number of node, internode length, number of leaf/plant, petiole length and girth, leaf length and width, number of branch/plant have reduced at high concentration of ethylene solution (1.5ml) T1. Abeles (1971) stated that the presence of high level of ethylene prevents the inhibition of internode elongation and leaf expression play a primary role. Ethylene treatments showed that reduced the vegetative growth than control plants. These observation was in agreement with Verma (2003) reported that ethylene has the role in increasing in stem girth. Salisbury and Ross (1992) stated that the ethylene inhibited stem elongation, increased in stem diameter and horizontal growth habit. Ethylene has ability to alter sex expression in number of cucurbits (Warner *et al*., 1969). The statistical analysis of the present study revealed that female flowers were significantly increased in ethylene concentration at (1.0ml) T2 than (control) T4. This result was in agreement to Srivastava (2012) Saltveit (1998) reported that ethylene changes sex expression in unisexual plants. It increases female flowers in several members of cucurbitaceae. In the present study, T2 (1.0ml) treatment of plants gave the highest number of female flowers. Abeles (1971) reported that ethylene can promote flowering, inhibit flowering or change the sex expression of monoecious plants such as cucurbits.T2 (1.0ml) treated plants in all treatments also gave the maximum yield in this investigation.T2 (1.0ml) was the sweetest in all treatments, when compared to the sweetness of fruits.

Acknowledgements

I wish to express my sincere thanks to Dr. Aye Pe, Professor and Head, Department of Botany, University of Yangon, for his encouragement and permission to this paper.

I would like to special thanks to Dr. Thanda Aye, Department of Botany, University of Yangon, for her invaluable guidance.

I would like to record my gratitude to Daw Ei Ei Htwe, staff officer from VFRDC, for her generous helps and suggesting for the research.

References

Abeles, F. B., P.W.Morgan and M.E.Saltveit Jr.(1971) . Ethylene in plant Biology. 2nd Edit.San Diego.Academic Press.

Backer, C. A and R. C. Bakhuizan, V. D. Brink, Jr. (1963). Flora of Java P.Noordhoff-Groningen II

Dassanayake,M.D. (1997). Flora of Ceylon. VOL XI.A.A.Balkema /Rotterdam.

Hooker,J.D. (1879). Flora of British India.VOL II, London. L. Reeve and co.Ltd.

Hundley, H.G.and Chit Ko Ko. (1961). List of Trees,Shrubs,Herbs and Principal Climbers etc.Govt. Printing and Stationary,Rangoon.

Hutchinson.J, LL.D., F.R.S. (1967). The genera of flowering plants. VOL II.

Lawrence, G.H.M. (1951). Taxonomy of vascular Plants. 10th Edit. The MacMillan Co. Newyork. London.

Pratt, H.K. and J.D. Goeschl. (1969). Physiological Roles of Ethylene in plants. Annual Review of plant physiology, 20:541-584.

Rendle, A.B. (1952). The classification of flowering plants. VOL II. Univ. press Cambridge.

Saltveit, Mikal E. (1998). Effect of ethylene on quality of fresh fruits and vegetables. University of California, CA 95616-8631, USA.

Srivastava, H.S. (2012). Plant Physiology. Department of plant science, MIP Rohilkhand University, Bareily, India.

Salisbury, F.B. and C.W.Ross. (1992). Plant Physiology. Belmont. CA. Wadsworth. PP. 357-407, 531-548.

Verma, S.K. (2003). A Textbook of Plant Physiology and Biochemistry. S. Chand and Co.Ltd. New Delhi.

Warner, H.L.and A.C. Leopold. (1969). Ethylene Evolution from 2-chloroethyphosphornic acid. Plt. Physio.44:156-158.

Woeste, K. and J.J.Kieber. (1999). Characterization Arabidopsis Ethylene-over producing mutants: In Biology and Biotechnology

Yang. S.F. (1969). Ethylene Evolution from 2-chloroethylphosphonic acid. Plant Physiology, 44,1203-1204.

Website

https://www.agrifarming.in>snake gour.

https://en.m.filipinoherbshealing wonders/Tricho

https://en.m.wikipedia.org/wiki/Tricho

world/of/flowering/plants/com/articles/tricho