International Journal of Research
Available at https://pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 1
January 2019

Effects of Foliar Application of Beer (ethanol) on the Growth, Flowering and Fruit Setting of Bitter gourd *(Momordica charantia* L.) Plants

Shyamalee Kohombange*[1], R.G.A.S. Rajapaksha[1], Nandun Rathnasekara[2]

[1] Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka,

[2] Epsilon Crest Research, 6/6, 67, Ward Place, Colombo 07, Sri Lanka,

*Corresponding Author: *shyamaleekohombange@gmail.com*

Abstract:

Bitter gourd (Momordica charantia L.) is an important vegetable crop of several countries in the tropics. Beer brewing is an intricate process encompassing mixing and further elaboration of four essential raw materials, including barley malt, brewing water, hops and yeast. Foliar beer sprays resulted in significant growth stimulation in plants. The objectives of the present study were to examine the effects of beer on growth and flowering and fruit setting of bitter gourd plants. The study was conducted at an open field located in Horticultural crop Research and Development Institute, Gannoruwa (WU1). The experiment was laid out in a Randomize Complete Block Design (RCBD) with two treatments randomized in twelve replicates. The treatments were T_1 – beer (8.8% Ethanol) and T_2 – Control (without beer). Plants were established in pots and standard crop management practices were done throughout the study. Beer (Lion – Strong) was sprayed to the seedlings 15 days after sowing. Measurements were taken on growing, flowering and Fruit setting stages. The highest values of plant growth parameters and reproductive parameters were observed in T1, i.e. beer (ethanol 8.8%) applied treatments. On the other hand the lowest values were recorded from T2 (control of the experiment). Specially, advanced flowering and fruit setting, number of flowers per plant, number of female flowers per plant and number of fruits per plant were recorded from T1, i.e. beer (ethanol 8.8%) applied treatments. So, beer applied plants showed superior results in contrast to control with enhancing flowering as well as fruit setting performances.

Key words: *bitter gourd, beer, Flowering, Fruit setting*

Introduction

Beer is a fermented aqueous drink based on starch and flavored by hops. Beer brewing is an intricate process encompassing mixing and further elaboration of four essential raw materials, including barley malt, brewing water, hops and yeast. Beer is a complex mixture; over 400 different compounds have been characterized in beer which, in addition, contains macromolecules such as proteins, nucleic acids, carbohydrates and lipids. Some of the constituents of beer are derived from the raw materials and survive the brewing process unchanged. Others are the result of chemical and biochemical transformation of the raw materials during malting, mashing, boiling, fermentation and conditioning. Together all these constituents make up the character of beer but, in general, different beers and lagers contain different proportions of the same compounds rather than novel constituents. Nevertheless, accidental or deliberate contamination of beer with micro-

organisms other than yeast may well produce new metabolites. Beer constituents can be divided into volatile and non-volatile components [2].

Foliar applications of methanol on a range of C3 plants increased growth rate and harvestable yield. Three applications of 10% methanol increased growth rate and yield of tomatoes without any symptoms of phyto toxicity to leaves [5]. This data supported the hypothesis that the increase in growth was because of an inhibition of photosynthate loss as a result of photo-respiration [5]. Ethanol has also been shown to have effects in plant tissues, often associated with ethylene activity [1], [7], [8] & [3] and on stomatal resistance by its effect in removing leaf resin [4]. Young tomato plants were treated with foliar sprays of methanol and ethanol. Concentrations ranged from 5 to 20% v/v. foliar sprays resulted in significant growth stimulation. Both alcohols increased leaf and stem fresh and dry weights with the maximum increases at the highest concentrations tested [6].

The experiment reported here was designed to study the effects of foliar applied beer (8.8% ethanol) on the growth, flowering and fruit setting of bitter gourd plants under open field condition.

Methodology

The study was conducted at an open field located in Gannoruwa (WU1- Wet Zone area in Central Province), Sri Lanka. Plants were established in pots and standard crop management practices were done throughout the study. Beer - Lion Strong (8.8% ethanol) was sprayed at one week intervals after transplanting of seedlings in pots. 6: 30: 30 fertilizer mixture was used as recommended fertilizers. The experiment was laid out in a Randomize omplete Block Design (RCBD) with two treatments randomized in twelve replicates. The treatment was 8.8% ethanol concentration of beer applied to the seedlings to cover whole aerial parts of the plant as an aqueous spray by using a hand sprayer. Data were collected at one week intervals after first spraying. Measurements were taken on growth, flowering and fruit setting determining parameters.

The data obtained were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS) Studio 3.71 University Edition. Duncan's New Multiple Range Test (DNMRT) was performed to compare the differences among treatment means at $p=0.05$. Correlation analysis was used to determine the strength of the relationships between measured parameters of bitter gourd.

Results and Discussion

Foliar application of beer is significantly increased ($p>0.05$) plant height, number of leaves per plant, number of flowers per plant, number of female flowers per plant, number of male flowers per plant and number of fruits per plant. Plant girth was not significantly difference ($p>0.05$) compared to control i.e. without beer. Also no phytotoxic effects were observed on any foliar treated plants.

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Table 1 Evaluation of growth and reproductive parameters

	Plant Height (cm)	Plant Girth (cm)	No. of Leaves	No. of Flowers	No. of Fruits	No. of Male Flower	No. of Female Flower
Treatment 1 (T1)	198.92	2.00	140.00	26.00	6.83	24.50	1.50
Treatment 2 (T1)	161.75	2.00	108.17	17.00	4.08	16.42	0.58
P-Value	0.0022	-	0.0014	0.0002	0.0337	0.0005	0.0425
Mean Difference	Significant	Not Significant	Significant	Significant	Significant	Significant	Significant

Table 2: Correlation between each parameter

	Plant Height (cm)	No. of Leaves	No. of Flowers	No. of Fruits	No. of Male Flower	No. of Female Flower
Plant Height (cm)	1.00000					
No. of Leaves *(P-Value)*	0.66366 *(0.0004)*	1.00000				
No. of Flowers *(P-Value)*	0.70897 *(0.0001)*	0.70469 *(0.0001)*	1.00000			
No. of Fruits *(P-Value)*	0.79395 *(<.0001)*	0.70283 *(0.0001)*	0.66515 *(0.0004)*	1.00000		
No. of Male Flower *(P-Value)*	0.70525 *(0.0001)*	0.70191 *(0.0001)*	0.98602 *(<.0001)*	0.68560 *(0.0002)*	1.00000	
No. of Female Flower *(P-Value)*	0.22604 *(0.2882)*	0.21961 *(0.3025)*	0.36764 *(0.0772)*	0.07848 *(0.7155)*	0.20754 *(0.3305)*	1.00000

According to the above Table 2, all most all the parameters have significantly correlated each other except no. of female flowers. No. of female flowers has no significantly correlated with the any one of other parameters tested in the study. Among the correlated variable combinations no. of flowers and the no. of male flowers has a significant positive, strong correlation. This finding emphasized that male flowers are dominant group of flowers blooming in the plant which is used to the experiment and the female flowers are blooming randomly without any correlation with the total no. of flowers. However, other correlations are

emphasized that each variable has a significant moderate positive correlation with the final outcome. Especially, no. of flowers and the no. of fruits are significantly correlated with the plant height and the no. of leaves.

According to the Figure 1, foliar application of beer is significantly increased ($p>0.05$) number of days for flowering and fruit setting compared to the control i.e. without beer.

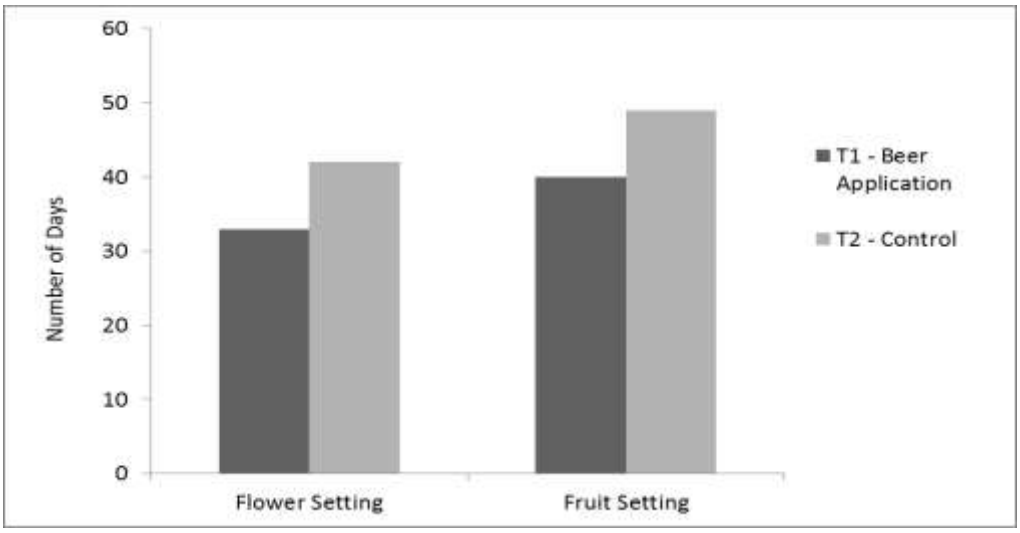

Figure 1 Evaluation of number of days for flowering and fruit setting

The increase in growth caused by methanol is the result of the inhibition of photorespiration [5]. This hypothesis however needs to be tested further as other mechanisms may be involved. Whatever the mechanism, use of methanol and possibly ethanol, to increase growth and reproductive parameters may provide significant benefits are also reflected in yield, on a range of agriculturally important C3 crop plants.

Conclusion

The highest values of plant growth parameters and reproductive parameters were observed in beer (ethanol 8.8%) applied treatments. On the other hand the lowest values were recorded from control of the experiment. Specially, advanced flowering and fruit setting, number of flowers per plant, number of female flowers per plant and number of fruits per plant were recorded from beer (ethanol 8.8%) applied treatments. So, beer applied plants showed superior results in contrast to control with enhancing flowering as well as fruit setting performances.

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