

Effects of Foliar Application of “Sakkaraa” Brewing on the Growth, Flowering and Fruit Setting of Ridge gourd (*Luffa acutangula*) Plants under Greenhouse Condition

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Received: March 13, 2019; **Accepted:** March 20, 2019; **Published:** March 24, 2019

Abstract: Ridge gourd (*Luffa acutangula*) is an important vegetable crop of several countries in the tropics. “Sakkaraa”, Sri Lankan name for jiggery (solidified sugary product) made by sugar cane stem extract. Sakkaraa brewing is an intricate process encompassing mixing and further elaboration of essential raw materials, including sugar, water and yeast. Foliar Sakkaraa brewing (yeast extract, 0.5% ethanol and 3% methanol) sprays resulted in significant growth stimulation in plants. The objectives of the present study were to examine the effects of Sakkaraa brewing on growth and flowering and fruit setting of ridge gourd plants. The study was conducted at greenhouse located in Horticultural crop Research and Development Institute, Gannoruwa (WU1). The experiment was laid out in a Complete Randomize Design (CRD) with three treatments randomized in twelve replicates. The treatments were T₁–40% Sakkaraa brewing, T₂–30% Sakkaraa brewing and T₃–Control (without Sakkaraa brewing). Plants were established in pots and standard crop management practices were done throughout the study. Sakkaraa brewing 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 Sakkaraa brewing applied treatment. On the other hand the lowest values were recorded from control of the experiment. Specially, advanced flowering and fruit setting were recorded from T₁, i.e. 40% Sakkaraa brewing applied treatments. So, Sakkaraa brewing applied plants showed superior results in contrast to control with enhancing flowering as well as fruit setting performances.

Key words: Ridge gourd, Sakkaraa brewing, Flowering, Fruit setting.

Citation: Shyamalee Kohombange, Rajapaksha, R.G.A.S. and Nandun Rathnasekara. 2019. Effects of Foliar Application of “Sakkaraa” Brewing on the Growth, Flowering and Fruit Setting of Ridge gourd (*Luffa acutangula*) Plants under Greenhouse Condition. International Journal of Current Innovations in Advanced Research, 2(3): 23-28.

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Introduction

“Sakkaraa” brewing is a fermented aqueous drink based on cane sugar and yeast (*Saccharomyces cerevisiae*). Sakkaraa brewing is an intricate process encompassing mixing

and further elaboration of essential raw materials, including cane sugar, water and yeast. It contains 5×10^8 yeast cells per 1 mm^3 , 0.5% ethanol, 3% methanol and P^{H} of the Sakkaraa brewing is 4.29.

Yeast as a natural source of cytokinins-stimulates cell division and enlargement as well as the synthesis and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Kraig and Haber, 1980; Spencer *et al.*, 1983; Casel franco and Beale, 1983; Fathy and Farid, 1996). It is used as a kind of biofertilizers in soil fertilization or in foliar application on the shoots of vegetable crops (El-Ghamring *et al.*, 1999). This is because it's content of many nutrient elements and being productive compounds of semi growth regulator compound like auxins, gibberellins and cytokinins (Glick, 1995). Moreover, Gomaa *et al.*, (2005) reported that inclusion the foliar application of yeast to the organic fertilization significantly increased potato yield in comparison with either the positive control or the corresponding treatments. Also, Hussain and Khalaf, (2007) found that spraying yeast solution treatments significantly increased plant height, number of branches/plant, dry matter of vegetative growth, number of tubers/plant, dry matter percentage of tubers, yield/plant, dry matter percentage of tuber, yield/plant and TSS. All the above mentioned characters were increased with increasing the foliar application of yeast treatments.

Recently, Sarhan and Abdullah, (2010) mentioned that the treatments of yeast suspension caused gradual significant increase in plant height, number of aerial stem, leaves area, total chlorophyll and shoots dry matter percentage. Likewise, El-Tohamy *et al.*, (2008) found that foliar application of yeast increasing cytokinins content especially at the high level of yeast (10 g/l). Yeast treatments had the best results concerning yield as well as N, P and K contents in the leaves.

Nonomura and Benson (1992) showed that 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. Nonomura and Benson's (1992) data supported the hypothesis that the increase in growth was because of an inhibition of photosynthate loss as a result of photo-respiration. Ethanol has also been shown to have effects in plant tissues, often associated with ethylene activity (Heins 1980; Saltveit 1989; Wu *et al.*, 1990; Mencarelli, 1991) and on stomatal resistance by its effect in removing leaf resin (Meinzier *et al.*, 1990).

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 (Rowe *et al.*, 1994). 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 in bitter melon (Kohombange *et al.*, 2019). The experiment reported here was designed to study the effects of foliar applied Sakkaraa brewing (yeast extract, 0.5% ethanol and 3% methanol) on the growth, flowering and fruit setting of ridge gourd plants under greenhouse condition.

Methodology

The study was conducted at a greenhouse located in Horticultural Crop Research and Development Institute, 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. Sakkarāa brewing (yeast extract, 0.5% ethanol and 3% methanol) was diluted at 40% and 30% and 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 Completely Randomize Design (CRD) with three treatments randomized in twelve replicates. The treatments of 40% and 30% Sakkarāa brewing applied to the seedlings to cover whole aerial parts of the plant at one week intervals 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.

Treatments	Sakkarāa brewing levels (%)
T1	40% dilution of Sakkarāa brewing
T2	30% dilution of Sakkarāa brewing
T3	Control (without Sakkarāa brewing)

The data obtained were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS) 9.1. 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 ridge gourd.

Results and Discussion

According to the table 1, there is no significant difference between T1 i.e. 40% Sakkarāa brewing and T2 i.e. 30% Sakkarāa brewing on plant height, number of leaves per plant, number of flowers per plant and number of fruits per plant. But, there is a significant difference between T1 i.e. 40% Sakkarāa brewing and T2 i.e. 30% Sakkarāa brewing on number of days for flowering and fruit setting. These results numerated that, foliar application of Sakkarāa brewing is significantly increased ($p>0.05$) plant growth and reproductive parameters compared to control i.e. without Sakkarāa brewing. Also no phytotoxic effects were observed on any foliar treated plants.

Table 1. Evaluation of plant growth and reproductive parameters of Ridge gourd

Treatment	Mean plant height (cm)	Mean number of leaves per plant	Mean number of flowers per plant	Mean number of fruits per plant	Mean number of days for flower setting	Mean number of days for fruit setting
T1	308.06 ^a	41.5 ^a	12.31 ^a	4.44 ^a	29 ^a	34 ^a
T2	269.94 ^a	35.44 ^a	8.94 ^{ab}	3.88 ^a	34 ^b	41 ^b
T3	200.75 ^b	22.18 ^b	3.13 ^b	0.18 ^b	38 ^c	48 ^c

Note: Means followed by the same letter/s along the column are not significantly different at $P=0.05$

When linear correlation analysis was performed for the overall data set, there was a highly significant ($p<0.0001$) positive correlation between number of leaves per plant and number of flowers per plant, plant height, number of leaves and flowers per plant and number of days for flowering and number of days for fruit setting. On the other hand there was a significant ($p<0.05$) positive correlation among plant height and number of fruits per plant. Number of fruits per plant showed a non-significant correlation with number of flowers per plant and

number of leaves per plant.

Table 2. Correlation between each parameter

	Plant height (cm)	Number of leaves per plant	Number of flowers per plant	Number of fruits per plant	Number of days for flower setting	Number of days for fruit setting
Plant height (cm)	1.00000	0.92146***	0.92186***	0.71730**	-0.76809**	-0.77801**
Number of leaves per plant	0.92146***	1.00000	0.93909***	0.55419 ^{ns}	-0.78754**	-0.80019**
Number of flowers per plant	0.92186***	0.93909***	1.00000	0.53950 ^{ns}	-0.69906*	-0.70745*
Number of fruits per plant	0.71730**	0.55419 ^{ns}	0.53950 ^{ns}	1.00000	-0.64914*	-0.66868*
Number of days for flower setting	-0.76809**	-0.78754**	-0.69906*	-0.64914*	1.00000	0.99795***
Number of days for fruit setting	-0.77801**	-0.80019**	-0.70745*	-0.66868*	0.99795***	1.00000

Note: ^{ns} non-significant at $p \geq 0.05$; * significant at $p < 0.05$; ** significant at; $p < 0.01$; *** significant at $p < 0.0001$

Conclusion

The highest values of plant growth parameters and reproductive parameters were observed in Sakkaraa brewing (yeast extract, ethanol 0.5%, methanol 3%) applied treatments. On the other hand the lowest values were recorded from control of the experiment. Specially, advanced flowering and fruit setting were recorded from 40% Sakkaraa brewing applied treatments. So, Sakkaraa brewing applied plants showed superior results in contrast to control with enhancing flowering as well as fruit setting performances.

Acknowledgement

Ms. Anoma Senarathna, Assistant Director of Agriculture (Research), Food Research and Development Unit, Gannoruwa and A.D. Dishan C. Dharmasena, Attorney-at-law, No: 762, Romiyel Mawatha, Panagoda, Homagama.

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