

# Yield Performance of Bell Pepper (*Capsicum annuum*) as Influenced by Different Plant Extracts

Jayrome S. Butay, MSA<sup>1</sup>, Laarni B. Trinidad<sup>2</sup>, Norie S. Diagan<sup>3</sup>  
Cagayan State University-Gonzaga Campus, Gonzaga, Cagayan,  
Philippines  
gilbertmagulod\_rdecusulasam28@yahoo.com

Asia Pacific Journal of  
Multidisciplinary Research  
Vol. 6 No.4, 60-65  
November 2018 Part II  
P-ISSN 2350-7756  
E-ISSN 2350-8442  
www.apjmr.com  
CHED Recognized Journal  
ASEAN Citation Index

Date Received: March 3, 2018; Date Revised: November 13, 2018

**Abstract** –The study was therefore design as an additional guideline for the farmers to enrich and to give them information on the advantages of using fermented plant juice and carrageenan that can help to improve their practices and to increase their production in bell. It was conducted because of the insurmountable rising cost of inorganic fertilizers. The farmers have to look for alternative measures to sustain the profitability of their farming business by assessing the yield performance of bell pepper as influenced by different fermented plant extracts, a study was conducted at the Cagayan State University – Gonzaga, Cagayan , Philippines from October 2016 to March 2017 with the following treatments: T1- Control, T2 – plants treated with Fermented Plant Juice (FPJ) and T3 - plants treated with Carrageenan, arranged in Randomized Complete Block Design with three replications. The treatments have no significant effect on the average number of fruits per plant and average yield tons per hectare. Treated Fermented Plant juice and Carrageenan affected the average weight of fruits per plant as manifested by heavier fruits per plant. Plant treated with FPJ proved to be more efficient as indicated by the highest ROI of 28.92 percent. The study revealed that plant treated with FPJ and Carrageenan improved Bell pepper production. Further study is recommended to validate the result and come up with a more reliable conclusion.

**Keywords** –carrageenan, fermented plant juice, foliar fertilizer

## INTRODUCTION

The increasing human population and rapid urbanization decreases the land for agriculture necessary for the production and cultivation of vegetable crops. Efficiency in agricultural production cannot be overemphasized because agricultural production can be expanded and sustained by farmers through efficient resource use for food sufficiency.

Bell pepper (*Capsicum annuum L.*) is a wonderful combination of tangy taste and crunchy texture. They may be eaten cooked or raw such as in salads and use as a seasoning to different kinds of dishes. It contains an impressive list of plant nutrients. It is an excellent source of vitamin A, vitamin C, vitamin B6, folate, molybdenum, vitamin E, dietary fiber, vitamin B, pantothenic acid, niacin and potassium that are known to have disease preventing and health promoting diseases [1]. Bell peppers are valuable commodity that is sold through farmer's markets as well as wholesales markets and restaurant sale.

At present, the Department of Agriculture is now promoting good agricultural practices wherein it includes the using of organic foliar spray in plants that can

improve and increase production but in the locality most farmers are not adopting this kind of technology because they just want to stay on their old practices. And in the locality there are only few farmers who are producing bell pepper because of the weather condition, pest, diseases and some other factors that affect the yield performance of it.

Foliar fertilizers immediately deliver nutrients to the tissues and organs of the crop. The leaves are factories where photosynthesis produces compounds needed for growth. These are absorbed right at the site they are used acting fast. For instance, eighty percent of the phosphorus applied through conventional fertilizers may get fixed up in the soil but up to 80 percent of the foliar-added phosphorus is directly absorbed [2].

Fermented plant juice (FPJ) or Bless Green Soup or Tankei Ryokujyu is made by fermenting plant parts in brown sugar. Sprout and baby fruits with high hormone concentration, full grown fruits, flower abundant in honey, and any plant with strong vigor are good ingredients. It is an ingredient in bokashi production and can also be used by applying directly to soil and plants. FPJ is produced from the fermentation of plant leaves, grasses, thinned crop plants, auxiliary buds or young

fruits and flowers (Jensen et al, 2006). It contains Plant hormones and micronutrients that stimulate the growth of beneficial microorganisms. The common materials being used in the Philippines are kangkong (*Ipomoea aquatica*), Sweet potato (*Ipomoea batatas*) and kakawate leaves [3].

When the plant suffers from certain nutrient deficiencies, liquid fertilizer is a faster and effective way to deal with the problem than solid fertilizer, which needs time to break down. The nutritional needs of plants change as they progress through different stages of growth. When used solid fertilizer, the same fertilizer continues to break down even though the plants growing needs are changing. Since liquid fertilizer can be taken up immediately by plants, feed the plants with different nutrients as they pass from seed to root to root to stem and foliage growth; then (for some plants) to flowering and fruiting. FPJ promotes beneficial microbial activities in the soil. The microbes help break down minerals and convert nutrients to a more absorbable form for plants and it help to improve soil quality and fertility [4].

According to the different field tests done by Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) carrageenan can strengthen the rice plant's resistance against natural disasters, and the crop can grow stronger and healthier with longer panicles and increased yield. It is also a safer alternative, more usable in small scale farms and more affordable [5].

According to Dr.Magsino, carrageenan can bolster plant growth development and strengthen the plants immune system, preventing diseases such as rice tungro, which causes leaf discoloration and sterility, and bacterial leaf blight. It can also keep away harmful pests by attracting natural enemies. It is an environmental friendly since it is made of natural ingredients and does not expose farmers to harmful health risks. When used correctly carrageenan can significantly increase grain yield [6].

However, no data available yet for bell pepper, thus, the study was conducted to evaluate the effect of FPJ and Carrageenan on the yield of bell pepper. The study was therefore design to generate scientific information that is vital for Good Agricultural Practices (GAP) in production of bell pepper. It was conducted because it serves as an additional guideline for the farmers to enrich and to give them information on the advantages of using fermented plant juice and carrageenan that can help to improve their practices and to increase their bell pepper production.

## **OBJECTIVES OF THE STUDY**

Generally, this was conducted to determine the yield performance of bell pepper (*Capsicum annum*) as influenced by different plant extract. Specifically, it was conducted to: 1) Evaluate the yield of bell pepper as influenced by carrageenan and fermented plant juice (FPJ); 2) Identify which among the carrageenan and fermented plant juice is effective for bell pepper production; 3) Evaluate the yield performance of bell pepper as influenced by different plant extract has the highest return of investment.

## **MATERIALS AND METHODS**

### **Research Design**

This study is an experimental research using Randomized Complete Block Design for agricultural experiments. The field is divided into units to account for any variation in the field. Treatments are then assigned at random to the subjects in the block-once in each block [7].

### **Securing of the seeds and fertilizer**

The seeds of Open Pollinated Variety (OPV) bell pepper and Agricultural lime were secured from DA-SCRC, Iguig, Cagayan, one of the Research Outreach Stations of the Department of Agriculture RFO No. 02. The inorganic fertilizer and pesticide were secured at nearest agricultural farm supply.

### **Land Preparation**

The experimental area of 243.75 square meter was thoroughly prepared for uniform growth and good root development. Each plowing was followed by harrowing to level and pulverize for effective weeds control.

### **Application of Lime**

Application of lime was done in order to meet the 6-8 pH requirement of bell pepper in the experimental area. It was broadcasted evenly into the field followed by another plowing to incorporate thoroughly into the soil. After a month, the field was plowed again and prepared prior to planting.

### **Raising of Seedlings**

Seeds were raised on seedling trays. The sowing medium was a mixture of garden soil, vermi compost, and carbonized rice hull with a ratio of 1:1:1. One seed was sown per cell in the seedling tray. The seedlings were watered as needed. The seedling was hardened prior to transplanting by decreasing the amount of water and gradually exposing them to direct sunlight.

### **Laying-out the Experimental Area and Experimental Design**

The prepared area was divided into three equal blocks, each block has a dimension of 3.6 meters x 19.5

meters. Each block was subdivided into three equal plots measuring into 6 meters x 3.6 meters and with spacing of .85 meters between plots. The experimental treatment was randomly allocated following the randomization procedure for Randomized Complete Block Design (RCBD).

### Experimental Treatments

The experimental treatments used the following treatments: T1 – Control, T2 – Fermented plant juice (FPJ) and T3 – Carrageenan.

### Transplanting of Seedlings

Transplanting was done after four weeks from seedling when plants develop four to five true leaves. Seedlings were laid at a distance of 60 cm between furrows and 40 cm between hills. The seedlings were transplanted at a rate of one seedling per hill in the late afternoon to avoid dehydration, too much exposure from sunlight and for fast recovery. It was watered immediately to establish good root soil contact. Missing hills were replanted after one week of transplanting.

### Care and Management of the Crop

Water Management. Watering of plants was done early in the morning to prevent rapid development of bacterial wilt.

#### Cultivation and Weeding

Cultivation and Weeding. Cultivation and weeding was done for removing weeds and for loosening the soil to optimize the retention and penetration of air, water and nutrients.

Fertilizer Application- In the application of fertilizer, vermi compost and ammonium phosphate were used as basal fertilizer while ammonium sulphate and urea were used as a side dress based on the soil analysis. Spraying of organic fertilizer was done early in the morning because the stomata, (pores on plant leaves), are open during these hours which hastens the absorption of foliar spray.

Control of Insect Pest- For insect pest management, hand picking was done. However, spraying of insecticide was done when severe infections occur. Lannate (insecticide) was used to minimize the attacked of insects in the experimental area and it was sprayed once.

### Harvesting

Harvesting was done around 80 to 90 days after transplanting as soon as the peppers reached the desired size and have a matured green fruits, or when the fruits are at the breaker stage where streaks of red are beginning to appear.

### Data Gathered

Average Number of Fruits per Plant- The ten sample plants were selected randomly excluding boarder rows. The total fruits harvested from ten sample plants was taken and counted and shall be divided by the number of sample plants.

Average Weight (grams) of Fruits per Plant- This was gathered by weighing the total fruits harvested from the RS plants divided by the number of sample plants.

Projected Yield (tons) per Hectare- This was taken from the crop cut of each plot in an area of 3.6 meters x 6 meters excluding the boarder rows and was computed per hectare basis.

Cost and Return Analysis- This was computed based on the gross income minus actual expenditures to get the net income. For the ROI, net income divided by total expenses multiply by 100.

### Statistical Analysis

All data gathered and analysed following the Analysis of Variance for the Randomized Complete Block Design. The Duncan's Multiple Range Test (DMRT) was used for the comparison of means with significant results .

## OBSERVATION AND DISCUSSION OF RESULTS

### Observation

Chemical and Physical Properties of the Experimental Area- The soil in the experimental area was clay loam with OM – 1.3%, P – 14 ppm, K – 200 ppm and soil pH of 4.8.

Stand and Vigor of the Crop. One month after transplanting, all plants applied with Fermented fruit juice (FFJ) and Carrageenan exhibited good stand with robust and greener leaves. Three months after transplanting, The T1 – control, it was observed that the plants had a mottled with yellow, white and light and dark green spots on leaves and the leaves have a blister like appearance. Some of the plants were also stunted and had grown poorly and have deformities.

Occurrence of Insect Pest- It was observed that aphids (*Aphis fabae*) and flea beetle (*Chaetochne mapulicaria*) were noticed in all treatment at 30 days after transplanting. The above-mentioned pests were managed through application of chemicals control such as lannate (insecticide).

Flowering and Fruiting Stage- it was observed that among the treatments, T2 (FPJ) and T3 (Carrageenan) bear flowers earlier and developed fruits first.

**Discussion of Results**

The Table 1 shows that plants on T<sub>2</sub> (Carrageenan) had the highest average number of fruits with the mean of 2.15, followed by T<sub>3</sub> with the mean of 2.17 and T<sub>1</sub> had the lowest average number of fruits with the mean of 1.60.

**Table 1. Average Number of Fruits per Plant of Yield Performance of Bell pepper as Influenced by Different Plant Extract.**

Treatments	Average Number of Fruits per Plant
T1- Control	1.60
T2- Fermented Fruit Juice (FFJ)	2.15
T3- Carrageenan	2.17
ANOVA Result	ns
CV %	16.48

Result showed no variation among the different treatment on the average number of fruits per plant. It was found out that T<sub>3</sub> gain the highest number of fruits compared to the other treatment.

**Average weight (g) of fruits per plant.** The Average weights of fruits per plant of yield performance of bell pepper as influenced by different plant extract are shown in Table2. Significant differences among the treatment means were recorded on the average weight of bell pepper. A heaviest fruit was obtained by the application of FPJ (T<sub>2</sub>) and carrageenan (T<sub>3</sub>) with a means of 56.17 grams and 53.65 grams. The lightest average weight of fruits was found on the control plants (T<sub>1</sub>) with mean value of 35.59 grams.

**Table 2. Average of weight (gram) per fruits per plant of Yield Performance of Bell pepper as Influenced by Different Plant Extract.**

Treatments	Average of weight per fruits per plant (gram)
T1- Control	35.59 <sup>b</sup>
T2- Fermented Fruit Juice (FFJ)	56.17 <sup>a</sup>
T3- Carrageenan	53.65 <sup>a</sup>
ANOVA RESULT	*
CV %	10.85

The result indicates that plant sprayed with FPJ produced the heaviest weight of marketable fruits [12]. And give more nitrogen to plants and enhances the ability of plant to photosynthesize or make their own food. It

also give additional phosphorus and help plants absorb more phosphorus from the soil [8].

Application of carrageenan can bolster plant growth development and strengthen the plant immune system [6].

Since the application of FPJ and Carrageenan is foliar feeding these produces an almost immediate effect on the plants. The nutrients provided are already in the form that the plant needs. After absorption, all the plant has to do is utilize these nutrients [9]. Foliar feeding is the best way to grow plants in places where there is no enough water. This is because the plant will absorb water through its roots. Foliar nutrition results are highest when the plant is showing high growth activity, going from the vegetative to reproductive stage and when deficiencies are present or when the crop has been damaged. To achieve the best results, the foliar product should contain nitrogen, to act as an electrolyte to carry the other nutrients and phosphorous, to move the nutrients within the plant [10].

**Average Projected Yield (tons) per Hectare.** The Average projected yield per hectare of bell pepper as influenced by different plant extract is presented in Table 3. Result showed no variation among the different treatment on the yield per hectare with mean values ranging 2.17 to 3.82 tons.

**Table 3. Average of Projected Yield per Hectare in tons of Yield Performance of Bell pepper as Influenced by Different Plant Extract.**

Treatments	Average of Projected Yield per Hectare in tons
T1- Control	2.17
T2- Fermented Fruit Juice (FFJ)	3.82
T3- Carrageenan	3.17
ANOVA RESULT	ns
CV %	31.86

Among the treatments tested T<sub>2</sub> gains the highest average projected yield tons per hectare with (82.80) this might be due to the Fermented Plant Juice that sprayed to plant because[11], FPJ promotes beneficial microbial activities in the soil. The microbes help break down minerals and convert nutrients to a more absorbable form of plants and it help to improve soil quality and fertility [4].

**Cost and Return Analysis**

The cost and return analysis of one hectare bell pepper is shown in Table 4. The return of investment obtained

in the different treatments are arranged in descending order. T<sub>2</sub> (FPJ) had 28.93 percent, T<sub>3</sub> (Carrageenan) had 21.12 percent and the lowest was obtained by T<sub>1</sub> with 16.77 percent.

**Table 4. Cost and Return Analysis**

Treatment	Cost of Production	Gross Income	Net Income	ROI (%)
T1- Control	325,090.5	278,393.28	(46,697.22)	16.77
T2- FFJ	347,900.55	489,503.04	141,602.49	28.93
T3- Carrageenan	347,900.55	441,046.56	93,146.01	21.12

Results showed that farmers can gain the highest profit from T<sub>2</sub>Php. 141,602.49v followed by T<sub>3</sub> Php. 93,146.01 and T<sub>1</sub> shows no profit due to its low production at high cost.

**CONCLUSION AND RECOMMENDATION**

Generally, this was conducted to determine the yield performance of bell pepper (*Capsicum annum*) as influenced by different plant extract. Specifically, it was conducted to evaluate the yield of bell pepper as influenced by carrageenan and fermented plant juice, to identify which among the carrageenan and fermented plant juice is effective for bell pepper production and to evaluate the yield performance of bell pepper as influenced by different plant extract has the highest return of investment. The results of the study are summarized as follows: 1) Average number of fruits was not affected by the application of FPJ and Carrageenan. However, it was observed that the application of FPJ obtained the highest average number of fruits per pant; 2) Heaviest average of weight per fruits plants in grams was obtained by the application of FPJ and Carrageenan; 3) Average of projected yield per hectare in tons was not affected by the application of FPJ and Carrageenan, However, the T<sub>2</sub>- FPJ obtained the highest projected yield in tons per hectare followed by T<sub>3</sub>- Carrageenan and T<sub>1</sub>- Control had the lowest projected yield.

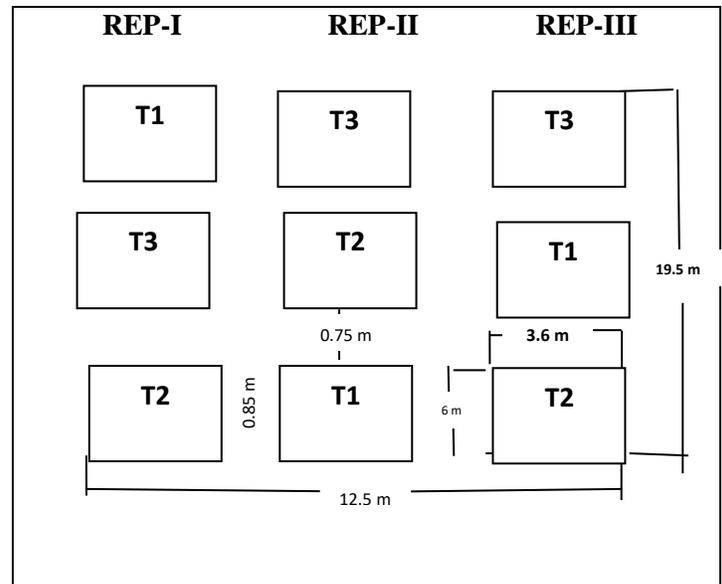
The application of FPJ produced more number of fruits, heaviest weight of fruits and highest return of investment with 28.93 percent.

The implication of this study to the community is to minimize the cost of production in case most farmers cannot grow bell pepper for market purposes because of the high cost of commercial foliar fertilizer.

This paper stresses that the application of FPJ is recommended because it obtained the highest and heaviest fruits and highest return of investment. Further it also recommends that other studies should be

conducted using other solanaceous crop to attest these two kind of foliar fertilizer.

**APPENDIX A: Experimental Layout Randomized Complete Bock Design**



**LEGEND:**

- Treatments:
- T<sub>1</sub> – Control
- T<sub>2</sub> – Fermented Plant Juice (FPJ)
- T<sub>3</sub> – Carrageenan
- Total Area – 243.75 square meter
- Block Size – 19.5 meter x 3.6 meter
- Plot Size - 6 meter x 3.6 meter
- Distance between Plot – 0.85 meter
- Distance between Block – 0.75 meter

**Appendix B: Procedure in Making FPJ**

**Materials Needed:**

- 1 kilogram kangkong shoot
- 1 kilogram molasses or brown sugar
- Plastic pale
- Paper
- String
- Bolo
- Chopping board
- Glass jars

**Procedure:**

1. Collect the materials early in the morning.
2. Chop and finely mix these with sugar or molasses.

3. Place the mixed material in a suitable container such as earthen jar, or plastic drum.
4. Cover the pot or drum with paper or cheese cloth.
5. Store in a cool dark place for 7-10 days to allow fermentation. The juice will change color from dark green to yellow brown or brown and would smell sweet and alcoholic.
6. After 7-10 days filter the material to extract the juice.
7. The FPJ can be stored in a glass or plastic bottle in a cool, dark place for up to 6 months. It is important not to tighten the cap completely on the bottle to allow aeration. Shake the bottle once a week to provide air to the microorganism.

#### **Appendix C: Chemical Composition of Fermented Plant Juice (FPJ)**

Nitrogen (N)	0.52 %
Phosphorus (P)	0.89 %
Potassium (K)	0.89 %
Iron (Fe)	2.1 ppm
Zinc (Zn)	0.03 ppm
Manganese (Mn)	0.22 ppm
Copper (Cu)	0.05 ppm

#### **Appendix D: Chemical Composition of Carrageenan**

Nitrogen (N)	0.02 %
Phosphorus (P)	-
Potassium (K)	0.03 %
Calcium (Ca)	120 ppm
Magnesium (Mg)	9 ppm
Iron (Fe)	48 ppm
Zinc (Zn)	35 ppm
Cobalt (Co)	-
Manganese (Mn)	5 ppm
Copper (Cu)	0.40 ppm

#### **REFERENCES**

- [1] AMARSON, A. 2012-2017. "Bell Pepper 101: Nutrition Facts and Health Benefits" <https://www.healthline.com/nutrition/foods/bell-peppers>
- [2] Faiza-Als V, Valizadeh G. 2005. Study of the Effects of the Simultaneous Use of Phosphorus and Zinc on the Absorption of the Micronutrients and Phosphorus and on the Remaining Zinc in the Soil under Dryland Cultivation of the Wheat Cultivar Sardari. *The Seedlings and Seed Journal*, 21(2):241-267.
- [3] Maghirang, R.G. 2011. "Organic Fertilizer from Farm waste Adopted by farmers/library.php in the Philippines" <http://www.ffc.agnet.org/library.php>.
- [4] Han, K.C. "Fermented Fertilizer (2)-Fermented Plant Juice (FPJ), URL: <https://goo.gl/UmhfMj>

- [5] Padin, M.G. 2016. "PCAARD-eyes other uses for Carrageenan plant growth promoter" <http://www.businessmirror.com.ph>.
- [6] Magsino, G.L. 2016. "Carrageenan induced as plant food supplement at NCP's 40<sup>th</sup> anniversary" <http://www.uplb.edu.ph/component/k2/item/50140thanniversary>" in the Philippines"
- [7] Field Guide to Experimental Design, url: <http://www.tfrec.wsu.edu/ANOVA/index.html>
- [8] Mabolod, B.A. 2010. "Fermented plant juice (FPJ) as an organic fertilizer" <http://www.behealthyandwell.com.abut>
- [9] Berglund, D.R. 2002. Soybean Production Field Guide for North Dakota and Northwestern Minnesota Published in Cooperative and Support from the North Dakota Soybean Council.
- [10] Grot, N. and Guerinot, M.L. (2006). Molecular Aspects of Cu, Fe and Zn Homeostasis in Plants. *Biochim. BiophysActa.* 1763(7): 595-608.
- [11] Han, K. C. 2009. "Korean Natural Farming-Fermented Plant Juice" *Natural Farming Handbook* p.106-p.14, <http://Rooftopecology.wordpress.com>
- [12] Pagluan, E.R Anical R.V. (2010). "Growth and Yield Performance of different vegetables applied with organic fertilizer", url: <http://www.Agris.fao.org/agris-search>. Northwestern Minnesota. Published in Cooperative and with Support from the North Dakota Soybean Council.

#### **COPYRIGHTS**

Copyright of this article is retained by the author/s, with first publication rights granted to APJMR. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4>).