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Validation and Documentation of Organic Production Systems for Lettuce (*Lactuca sativa*) Camarines Sur, Philippines

Carmelita N. Cervantes[1*], Felipe P. Laynesa[2], Jobelly B. Pacis[3]

Central Bicol State University of Agriculture, Camarines Sur, Philippines.

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The study determined the productivity and economic performance of lettuce in different production systems in Camarines Sur, Philippines. Specifically, it aims to a) document local farmers' current organic and conventional practices; and b) compare the growth, yield and economic performance of lettuce in recommended organic production practices with local farmers' current organic and conventional practices. Current farmers' practices for lettuce organic production were documented through field surveys, observations and focus group discussions (FGD). The performance of production systems was determined through on-station trials which were conducted for 2 wet and 2 dry cropping seasons. It was set-up in randomized complete block design (RCBD) consisting of three production systems as treatments and replicated four times. The treatments were: T1 - Recommended organic production practices from University of the Philippines (UPLB), T2- Farmer's current organic production system; and T3 - Conventional production system recommended by Department of Agriculture (DA). Farmers in Camarines Sur grow lettuce organically. They use farm-produced vermicompost and tea, natural liquid supplements and pest control solutions. The vegetable is usually raised in fields not more than $1000m^2$. Growth and yield performance of plants in recommended organic system were generally similar with farmers' current organic production system and better than conventional system. Both organic production systems (T1 and T2) were more profitable than conventional system (T3). Highest ROI was obtained in T2.

Keywords: organic lettuce production, lettuce conventional chemical production, documentation and validation

Introduction

Organic agriculture (OA) can provide complete and long-term solutions to problems of food security, health, and environmental protection despite the challenges associated with limited science-based technologies, scarcity of organic inputs, high labor cost, and stubbornness of farmers at breaking the chemical-based farming habit.

In the Philippines, these challenges are being addressed comprehensively with the enactment of Philippine Republic Act 10068 or the

[*] **Coressponding Author:** Carmelita N. Cervantes ; **E-mail:** carmelita.cervantes@cbsua.edu.ph

Organic Agriculture Act of 2010. The law increased the interest in organic agriculture nationwide and intensified the development of OA through research and development.

At the moment, reliable information on the current practices and technologies on OA are generally lacking especially on high value vegetables. While some organic farming technologies are being promoted, many of them are still based on personal testimonies and anecdotes.

Lettuce is among the most important crops that need to be grown organically. It is the most sought green vegetables for salad and sandwiches. It contains incredible sources of essential nutrients and its benefit to health has been confirmed by modern scientific researches. The vegetable helps in proper digestion, promotes healthy liver, decreases the threat of heart diseases and stroke, lowering cholesterol levels, cancer control, protection of neurons, sleep induction, anxiety control, lowering inflammation, and providing a supply of antioxidants.

Hence, the study validated the organic technologies and current practices on lettuce production through scientific evaluation process. The study intended to help promote the organic crop production of for health, economic and environmental benefits.

Objective:Generally, the project aimed to validate and document the agronomic and economic performance of organic production systems for lettuce in Camarines Sur, Philippines. Specifically, the project aims to:

1. Document local farmers' current organic and conventional practices for lettuce production; and
2. Compare the agronomic and economic performance of recommended organic practices with local farmers' organic and conventional practices.

Materials and methods

Duration and Location of Experimental Site

The station-based validation trial was done for 2 dry seasons and 2 wet seasons from August, 2014 to April, 2016. It was conducted in the experimental area of the university . The area was fallowed for 2 years. After the fallow period, the area was used for organic pechay production were ordinary composts and carbonized rice hull were used to fertilize the vegetable.

Experimental Design and treatments

The experiment were set-up in randomized complete block design (RCBD) with three treatments and four (4) replications. Each plot measured 5m by 6 m. The treatments were sets of production practice or systems as follows:

T1 - Recommended organic production practices
T2- Farmer's current organic production system
T3- Conventional(chemical) production

In T1, the organic production practices were recommendations from University of the Philippines (UPLB); T2 were the current organic practices of farmers obtained from surveys and focus group discussions and T3 were recommendations from Department of Agriculture (DA).

Cultural Management Practices

Common cultural management practices were employed on land preparation, planting distances, seedling medium (1:1 carbonized rice hull and vermicompost), pricking time which was 10 days after sowing (DAS), irrigation and harvesting. Net tunnels were provided to protect seedlings from too much rain and sunlight. What varied among treatments were as follows:

For T1, 2 kgs/m^2 of *Gliricidia sepium* and other available green manure materials were incorporated in the soil during land cultivation 3 weeks before transplanting. At seedling stage, microbial inoculant (Mykoplus) slurry at 100g per 500 ml distilled water was spayed to seedlings in seedboxes. When seedlings were ready for pricking (10DAS), seedling roots were dipped in the slurry for 5 minutes and planted in seedling trays. Vermicompost at 2 kg/m^2 was applied to the field before transplanting. Rice straw mulch was applied one week after transplanting. Every week natural liquid concoctions such as vermitea and fermented plant juice (FPJ) were sprayed alternately at 2tbs per li of water. To control pests oriental herbal nutrient (OHN) was sprayed to the plants and hand weeding was done whenever necessary.

For T2, no green manure, microbial inoculant and mulching were applied. Seedlings at 10 DAS were pricked and planted in seedling trays. Vermicompost was applied per hill at .25kg/hill at transplanting. Vermitea and FPJ alternately every week at 2tbs per li of water. Oriental herbal nutrient (OHN) was sprayed to control insect pests and hand weeding was done to control weeds.

For T3, 10 g/hill of complete fertilizer was applied at transplanting and malathion was used to control to control insect pests and hand weeding to control weeds.

Data Gathered

Data were gathered on plant height, economic yield and economic returns. Soill changes, meteorological data and pest occurences were also observed.

Statistical Analysis

Appropriate ANOVA was done determine the significant differences, DMRT and Scheffe test was use to analyze the significant difference of parameters. Calculation will be done at 5% significance level.

Results and Discussion

Plant Height (cm)

The different production systems affected heights of lettuce plants at harvest (Table 1). For wet and dry seasons in year 1, T1 produced plants which were tallest at 12.45 cm and 12.77cm, compared to plants from T2 at 10.20 cm and 10.02cm, and T3 at 9.50cm and 9.22cm. The wet season in year 2 , it was T2 that produced the tallest plants at 10.25 cm while T1 and T3 produced statistically similar plant heights at 9.04cm and 8.79cm, respectively. During dry season, numerically the same plant heights were produced by T1 (13.79 cm) and T2 (13.64 cm) with height of T2 similar with T3 (13.47).

Table 1. Final height (cm) of lettuce plants grown in different production systems during the wet season (WS) and dry season (DS) planting. CBSUA. August, 2014 to April, 2016.

Treatment	**Mean Height (cm)**			
	Year 1		**Year 2**	
	WS	**DS**	**WS**	**DS**
T1-Recommended Organic Practices	12.45a	12.77a	9.04b	13.79a
T2-Farmer's Organic Practices	10.20b	10.02b	10.25a	13.64ab
T3-Conventional Chemical Practices	9.50b	9.22b	8.79b	13.47b
CV (%)	5.5	5.3	6.2	0.9

Means with the same letter are not significantly different at 5%p-level

Economic Yield (kg/1000m^2)

Economic yield (cleaned biomass weight including roots) of lettuce was not affected by different production schemes during the wet season but was influenced during dry seasons (Table 2). However, yields in the two organic production systems (T1 and T2) were higher than the chemical system (T3).

On the dry season of year 1, yield of lettuce was highest in T1 (1904.71kg) than T2 (1594.63kg) and T3 (1435.98kg). Both T2 and T3 had comparable yields. During the last planting season, T1 and T2 had similar yields (3037.83kg and 2825.65kg, respectively) which were significantly higher than the yields from T3 (2,222 kgs).

The better performance of organic fertilization than conventional methods on lettuce were documented in several researches. The use of chicken and cow manures produce better performance of lettuce than chemical fertilizers as lettuce in these treatments as *exhibited by higher values in number of leaves, plant height, marketable yield and mean leaf dry mass* (M. Masarirambi *et al.,* 2010; M. T. Masarirambi *et al.*, 2012). It was also observed that inorganic fertilization resulted to high nitrate content in lettuce leaves which can be detrimental to health (Pavlou *et al.*, 2007). However, organically grown lettuce using vermicompost were also found to be more nutritious in terms Mn, Mg, Ca, Fe, Cc, Zn, and lower Na (Castillo and Arras, 2010). In the study of Melero *et al.* (2006) crop yield was greater from organic than conventional fertilizer due to significant increases in TOC and Kjeldahl-N, available-P, soil respiration, microbial biomass, and enzymatic activities compared with those found under conventional management. They further stated that the positive correlation of biochemical properties ($p < 0.01$) with TOC and nutrient content and concluded that results organic management positively affected soil organic matter content, thus improving soil quality and productivity.

In this study, it was also observed that all heights and yields appeared to decrease from the 1st to 3rd cropping seasons. It was associated with root knot nematode problems in the field as found out in a separate study on nematodes in the same experiment. The symptoms such as stunting plants as observed in Table 1, swelling of roots and lower yields (Table 2) were indicators that lettuce is susceptible to nematodes, especially during continuous planting (Westerdahl and Ploeg, 2016). Crop rotation of different non-susceptible crop like mung bean can reduce the population of nematode in the soil (Kratochvil *et al.,* 2004) and other pests. Hence mungbean was grown during the period between the 3rd and last cropping of year 2. Increased in yield on the last cropping could be attributed to this intervention.

Table 2. Total economic yield (kg/1000 m^2) of lettuce grown in different production systems during the wet season (WS) and dry season (DS) planting. CBSUA. August, 2014 to April, 2016.

Treatment	Total Economic Yield (kg/1000m^2)			
	Year 1		Year 2	
	WS	DS	WS	DS
T1-Recommended Organic Practices	2610.81	1904.71a	1447.92	3037.83a
T2-Farmer's Organic Practices	2171.25	1594.63b	1552.08	2825.65a
T3-Conventional Chemical Practices	1962.83	1435.98b	1270.83	2222.79b
CV (%)	*21.1*	*10.2*	*10.5*	*8.1*

Means with the same letter are not significantly different at 5%p-level

Economic Analysis

Lettuce production in a 1000 m^2 using any production systems appeared to be a very profitable agri-enterprise because of extremely high economic returns (Tables 1 and 2). The staggering ROIs ranged from 5,319.44 % in conventional system to as high as 8,956.51% in organic systems. When the harvests were valued either using the prevailing market price of $2.00 per kilogram or the premium price for organically grown at $3.00 per kilogram, highest profits were observed when the vegetable was produced organically. The profits from T3 were lowest because of lesser yields.

Table 3. Summary of cost and return (average of 4 croppings) for lettuce in 1000m^2 grown in different production systems using the prevailing market price of $3.00/kg. CBSUA. Aug. 2014 – April, 2016.

Items	T1 - Recommended Organic Practices	T2 – Farmer's Organic Practices	T3 – Conventional Chemical Practices
Production Expenses ($)	77.54	67.44	63.59
Gross Yield (kg)	2,250.30	2,035.93	1,723.11
Gross Income ($)	4,500.60	4,071.86	3,446.22
Net Income ($)	4,423.06	4,004.42	3,382.63
ROI (%)	5,704.23	5,937.75	5,319.08

Table 4. Summary of cost and return (average of 4 croppings) for lettuce grown in 1000m^2 in different production systems using the premium price for organic lettuce of $3.00/kg and prevailing market price of $2.00/kg. CBSUA. Aug. 2014 – April, 2016.

Items	T1 - Recommended Organic Practices	T2 – Farmer's Organic Practices	T3 – Conventional Chemical Practices
Production Expenses ($)	77.54	67.44	63.59
Gross Yield (kg)	2,250.30	2,035.90	1,723.11
Gross Income ($)	6,750.95	6,107.71	3,446.22
Net Income ($)	6,673.59	6,040.27	3,382.63
ROI (%)	8606.35	8956.51	5319.08

To conclude, farmers in Camarines Sur grow lettuce organically. They use farm-produced vermicompost and tea, natural liquid supplements and pest control solutions for the crop.

In terms of growth and yield, plants from recommended organic system performed similarly with farmers' current organic production system and better than conventional system. Also, lettuce production is a very profitable venture, but growing them organically can give higher economic returns. Hence, ensuring the availability of production inputs at farm level will further enhance the practice of organic production systems.

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