BIBLIOGRAPHY

ALABAT, JOHN MARK LAPICTO. APRIL 2012. Packaging Practices at La Trinidad, Trading Post: It's Effect on the Incidence and Severity of the Postharvest Diseases of Cabbage (*Brassica oleracea* var. *pekinensis*). Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at La Trinidad Trading Post, La Trinidad Benguet from December to March 2012, to evaluate the effect of the packaging practices at La Trinidad Trading Post on the incidence and severity of soft rot (*Pectobacterium carotovorum*). Specifically, it aimed to identify the postharvest diseases associated with the packaging practices.

Results of the study revealed that there were no significant differences between treatments in terms of disease incidence and severity on the packaging materials which were polyethylene plastic bag without holes and polyethylene plastic bag with holes and also the unwrap, half wrap and whole wrap practice being done on cabbage for tranceport. It indicates that both polyethylene plastic without holes and polyethylene plastic with holes could be used as packaging materials of on cabbage.

Survey was also done to evaluate and identify the existing packaging materials at La Trinidad, Trading Post. The identified existing packaging materials were polyethylene plastic bag and red bag. The produce were being wrap with newspaper either half wrap and whole wrap before they pack it on the polyethylene plastics or red bag.

RESULTS AND DISCUSSION

Survey

There were 40 cabbage farmers who were interviewed and filled-up the survey questionnaire distributed. Data is presented on table form.

Age. The age of the respondent ranged from 19 to 65 years. Table 1 shows that thirty five percent and 22.5 percent belonged to the 41-50 and 31-40 age bracket. This shows that the respondents were generally middle aged. Of the remaining 20 %, 10% and 7.5 % fell under 51-60; 21-30; and 20 and below age brackets. Only 5 percent fall under 61 and above years.

Table 1. Age of 40 farmers

AGE	FREQUENCY	PERCENTAGE
20 and below	3	7.5
21 – 30	4	10
31 – 40	9	22.5
41 – 50	14	35
51 – 60	8	20
61 and above	2	5
TOTAL	**40**	**100**

Gender. As shown in Table 2; 82.5 percent of the respondents were males and 17.5 percent were females.

Table 2. Gender

GENDER	FREQUENCY	PERCENTAGE
Male	33	82.5
Female	7	17.5
TOTAL	**40**	**100**

Years in Cabbage Production. Table 3 shows that 55 percent of the respondents were engaged in cabbage production for more than 16 years; 17.5% for 11-15 years; 15% for 5-10 years and 12.5% for less than 5 years.

Table 3. Number of years in cabbage production

YEAR	FREQUENCY	PERCENTAGE
Less than 5 years	5	12.5
5 – 10 years	6	15
11 – 15 years	7	17.5
Above 16 years	22	55
TOTAL	**40**	**100**

Area of Cabbage Production. Table 4 showed the area of cabbage production being managed by the 40 farmers. 40 percent of the respondents have an area of 1000-5000 square meter; 27.5% on 5000-10 000 m^2; 22.5% on more than 10 000 m^2 or 1 ha and only 10% on less than 1000 m^2.

Table 4. Area in cabbage production

AREA in square meter (m^2)	FREQUENCY	PERCENTAGE
Below 1000 m^2	4	10
1000 – 5000 m^2	16	40
5000 – 10 000 m^2	11	27.5
Above 10 000 m^2	9	22.5
TOTAL	**40**	**100**

Bio-physical Characteristic of the Area. Table 5 shows that of the 40 farmers, 55 percent of them had been planting on slopping area; 35% on flat and 10 % on hilly.

Table 5. Biophysical characteristics of the area

CHARACTERISTICS	FREQUENCY	PERCENTAGE
Flat	14	35
Slopping	22	55
Hilly	4	10
TOTAL	**40**	**100**

Other crops planted. Table 6 showed that among the 40 respondents, 27percent said that they are planting potato other than their main crop which is cabbage. 21.90% and 18.98% were planting carrot and Chinese cabbage. 11.68% planting radish; 5.11% planting lettuce; 3.65% planting beans; 1.46% for pechay and garden pea; 2.19 for broccoli, onion leeks and pepper and 0.73% planting cucumber and strawberry

Table 6. Other crop grown

CROP/S	FREQUENCY	PERCENTAGE
Chinese cabbage	26	18.98
Potato	37	27.01
Carrot	30	21.9
Radish	16	11.68
Lettuce	7	5.11
Garden pea	2	1.46
Celery	1	0.73
Pechay	2	1.46
Cucumber	1	0.73
Beans	5	3.65
Broccoli	3	2.19
Onion leeks	3	2.19
Strawberry	1	0.73
Pepper	3	2.19
TOTAL	**137**	**100.01**

Diseases. As shown in Table 7, from the 40 respondent farmers, 37.23 percent answered that clubroot is the most rampant disease infecting their cabbage; 29.79% answered that leaf spot infects their cabbage; 19.15% answered soft rot; 12.77% answered black rot and only 1.06 answered damping off infecting their cabbage specially at the seedlings or at the young stage of the crop.

Table 7. Diseases infecting cabbage

DISEASE/S	FREQUENCY	PERCENTAGE
Club root	35	37.23
Soft rot	18	19.15
Black rot	12	12.77
Leaf spot	28	29.79
Dumping off	1	1.06
TOTAL	**94**	**100**

Disease Management. Table 8 showed that 22 respondents with a percentage of 52.38 were using fungicide such as Dithane, Brassicol, Curzate, Bondozeb, Manager, Saprol and Score in managing the disease/s of their cabbage. There were 11 respondent with 26.19% said that they were using lime against clubroot and other diseases, 9.52% is applying crop rotation, 7.15% applying eradication of infected part or the whole part of the cabbage and 4.76% is using fertilizer.

Table 8. Disease management

Management	FREQUENCY	PERCENTAGE
Fungicide	22	52.38
Crop rotation	4	9.52
Eradication	3	7.15
Fertilizer	2	4.76
Lime	11	26.19
TOTAL	**42**	**100**

Type of Vehicle used in Transporting Cabbage. Table 9 showed that 87.5% of the respondents were using truck (elf) in transporting their cabbage from their farm to La Trinidad trading post while 14% were using jeep (FordFiera). There were 2 of the respondents that is using van and Tamaraw Fx.

Table 9. Type of vehicle used in transporting cabbage from farm to trading post

VEHICLE	FREQUENCY	PERCENTAGE
Truck (elf)	35	71.43
Jeep (Fordfiera)	14	28.57
TOTAL	**49**	**100**

Distance of the Farm to the Nearest Road. As shown in Table 10; 62.5 percent of the respondents planted on areas which are less than 500 meter away from the nearest road; 27.5% in areas which is 500 m to 1000 m and 10% of them planted in areas which are above 1000 m.

Table 10. Distance of the farm to the nearest road

DISTANCE in meter (m)	FREQUENCY	PERCENTAGE
Less than 500 meter	25	62.5
500 – 1 000 meter	11	27.5
Above 1 000 meter	4	10
TOTAL	**40**	**100**

Protection Practices for Cabbage inside the Vehicle. Table 11 shows that among the 40 farmers, 85 percent of them are not using any protection practice or material for the

cabbage inside the vehicle, only 10% is using banana leaves and 2.5% is using newspaper and cartoon.

Table 11. Protection practices for cabbage inside the vehicle

PRACTICE/MATERIAL	FREQUENCY	PERCENTAGE
None	34	85
Cartoon	1	2.5
Newspaper	1	2.5
Banana Leaves/Trunk	4	10
TOTAL	**40**	**100**

Person who Determines the Purchase Price. As shown in Table 12; 52.5 percent of the 40 traders answered that buyers are the one who determines the price of the produce, 30% answered that the Growers is the one who determines/decides for the price and 17.5% answered both of the buyer and the grower decides/determines the price.

Table 12. Person who determines the purchase price

PERSON	FREQUENCY	PERCENTAGE
Grower	12	30
Buyer	21	52.5
Both	7	17.5
TOTAL	**40**	**100**

Factors Considered in Pricing. Table 13 shows that 43.75 percent of the 40 respondent answered that the volume is the main factor in giving price for the cabbage, 39.58% is because of the quality of the product, 14.58% is considering the size and 2.13% is because of the prevailing market prize.

Table 13. Factors considered in pricing

FACTORS	FREQUENCY	PERCENTAGE
Size	7	14.58
Volume	21	43.75
Quality	19	39.58
Prevailing Market Price	1	2.13
TOTAL	**48**	**100**

Source of technical information in packaging. As shown on table 14 the sources of technical information is from the buyers only.

Table 14. Source of technical information in packaging

SOURCES	FREQUENCY	PERCENTAGE
Supplier/Farmers	0	0
Trader	0	0
Buyer/s	40	100
BSU Technicians	0	0
DA Technicians	0	0
MAO Technicians	0	0
Total	**40**	**100**

Harvesting. According to the 40 respondents they were harvesting their cabbage early in the morning between 5 a.m to 8 a.m or 7 t0 10 a.m depending on the size of their farm and those who will carry the harvested cabbage from the farm to the nearest road. Their reasons is to catch up for the good or high price in the market, the crop will be transported earlier in order to avoid high temperature that may lead to the increase in respiration rate.

Quality Specification for Cabbage. The quality of the crop is based on its color and physical appearance. First class is with green color (Fig.1a) while trimmed cabbage which is white in color, without disease and insect damaged is considered at the second class (Fig.1b) and the third class is very white in color, smaller in size and with holes caused by insects.

a b

Figure 1a is first class and figure 1b is the second class.

Trimming . For the first class, 1-2 leaves of the crop that is with insect or handling damage are being removed after the transportation from the farm to Trading post. Diseased and insect damaged leaves are being trimmed with 4-6 leaves and this tends to lower the class and the price of the crop (Fig. 2a-b.)

Figure 2 (a-b). Trimming practice at LT Trading Post

Packaging. The most common packaging material being used in Trading post is polyethylene plastic bag and red bag. Polyethylene plastic bags and unwrap or half wrapped with newspaper are being used for short destination or it is for provincial routes while red bag and whole wrapped with newspaper are being used in far destination or longer transportation (Figure 3a-b-c).

Figure 3(a-b-c) a) Polyethylene plastic bags and unwrap cabbage
b) Polyethylene plastic bags and Half wrap cabbage
c) Red bag "tapal-tapal or whole wrap"

Storage. Most of the respondents answered that they are not storing their cabbage because they wait until it will be disposed. But some of them let their disposer with storage room store it in less than 12 hours if not disposed in the day.

Laboratory Study

Postharvest Disease Identification

The disease was identified as bacterial soft rot caused by *Pectobacterium carotovorum*. The first symptom of the disease at the base or cut stem of the cabbage is the tissue starts to decay and turns into soft, slimy, foul-smelling odor (Fig. 4a). The organism was isolated in an artificial media and it appears to be creamy, and also produces foul odor ''one day old culture'' (Fig. 4b). In the leaves, the symptom starts as a black, soft, watery decay and also produces a foul smell (Fig. 4c). From the advancing lesion 1-2 mm was cut and soak in water placed in a slide with cover slip, it was observed that the bacterium oozes from the cut section (Fig. 4d).

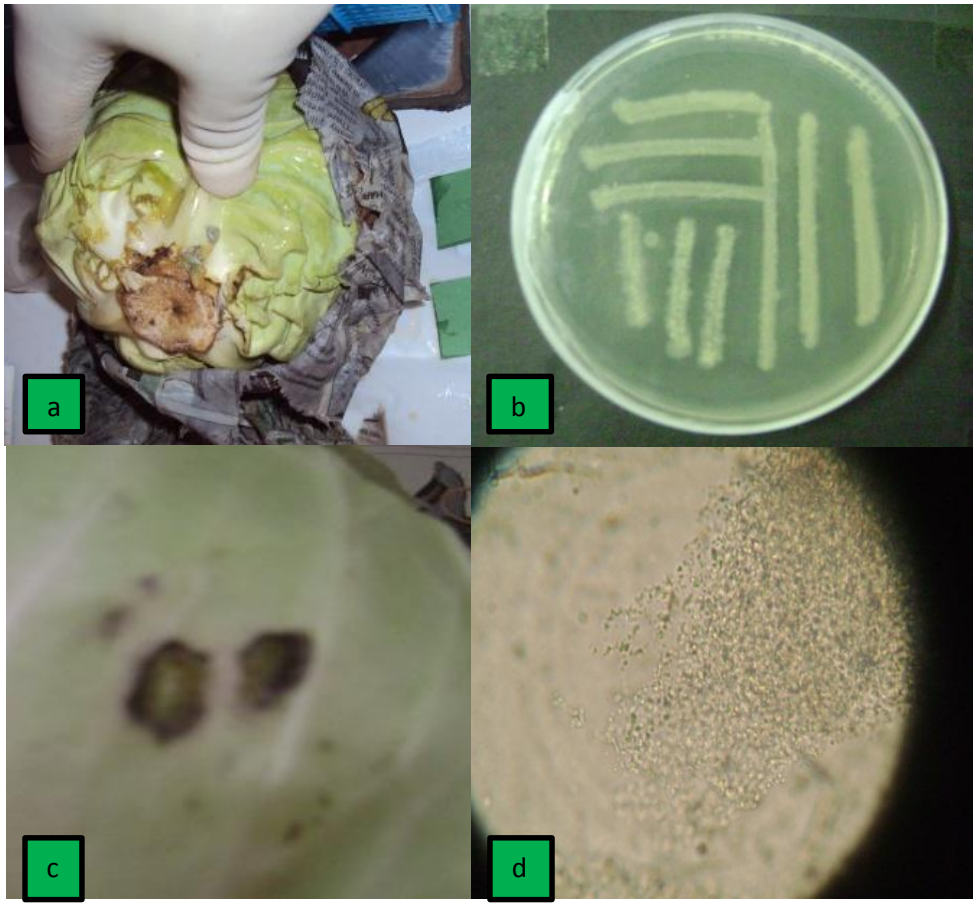

Figure 4(a). Base of the Cabbage showing the symptom of soft rot;
(b). Isolate of *Pectobacterium carotovorum*;
(c) Leaves showing symptom of soft rot;
(d) Oozing *Pectobacterium carotovorum* (40x)

Effect of Packaging Materials
on Postharvest Disease Incidence

The effect of plastic materials such as polyethylene films as packaging materials can affect the quality of the cabbage. This can cause high respiration rate and can enhance the development of postharvest diseases such as bacterial soft rot caused by *Pectobacterium carotovorum*. One by product of rapid respiration is water and heat. Plastic materials that were sealed restricts the carbon dioxide and vapor transfer or movement.

The use of newspaper in wrapping can reduce moisture accumulation in the surface of the products.

Disease Severity

The assessment of bacterial soft rot (*Pectobacterium carotovorum*) on cabbage packed on polyethylene plastic bags without holes is presented in Figure 5. The half wrapped cabbage had the highest infection rate with a mean of 2.17% (1-5% infection) followed by unwrapped and whole wrapped with a means of 2.06% (1-5% infection) and 1.67% (1-5 % infection) respectively.

The assessment of bacterial soft rot (*Pectobacterium carotovorum*) on cabbage packed on polyethylene plastic bags with holes was presented in Figure 5. The half wrapped cabbage had the highest infection rate with a mean of 1.72% (1-5 % infection) followed by unwrapped at 1.67% (1-5 % infection). Whole wrapped cabbage had the least infection at 1.61% (1-5 % infection).

The whole wrapped cabbage packed in the polyethylene plastic bags with holes gave the lowest mean of 1.61% (1-5 % infection) while the half wrapped packed in the polyethylene plastic bags without holes gave the highest mean. This indicates that it is better to use whole wrapped packed in the polyethylene plastic bag with holes. However, statistical analysis showed no significant differences among the treatment means as shown in Figure 5.

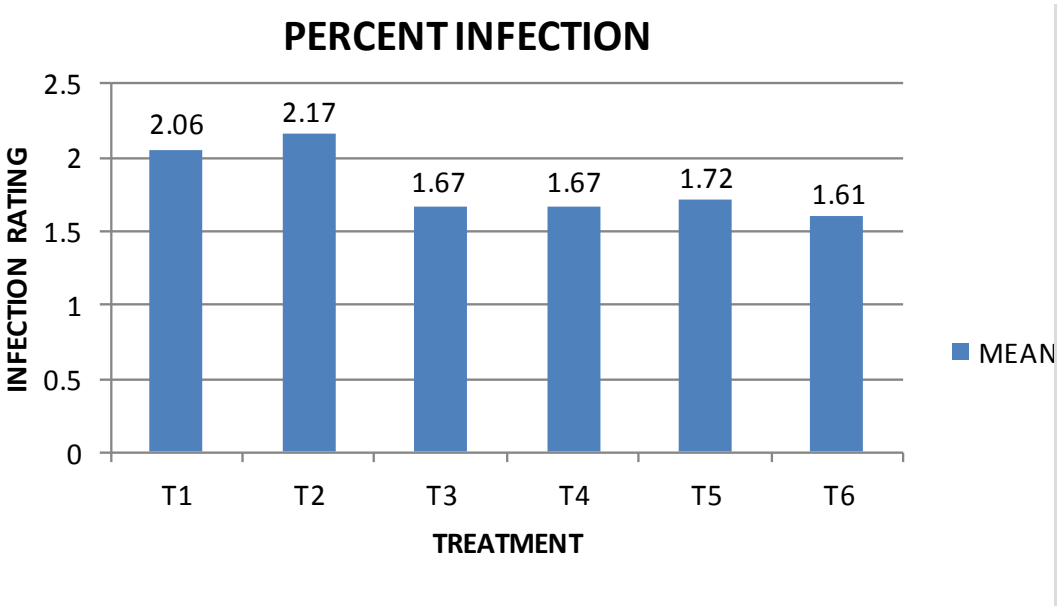

Figure 5: Percent Infection

Transportation to Urdaneta

Cabbage were packed by 15 kilograms per treatment with three replicate and transported from La Trinidad Trading Post to Urdaneta. The travel time was 4 hours. It was observed that there is no occurrence of any postharvest disease after the travel but the crop was damaged or "bruised" due to improper handling.

It was also observed that the "kargadors" were not aware of proper postharvest handling practices when they carried and fixed the crop in the cart and vehicle because they threw, stepped on it and they piled it forcefully. In their own perspective, it is a way of minimizing spaces but these practices favors the development of the disease.

Documentation of the Postharvest Losses,
Incidence and Severity in Using Red Bag
(Trading Post Practice)

The use of red bag is one packaging practice being done at La Trinidad Trading Post for cabbage and other crops such as Chinese cabbage, carrot and potato. This is commonly used for longer transportation to far places (Fig. 6a-b).

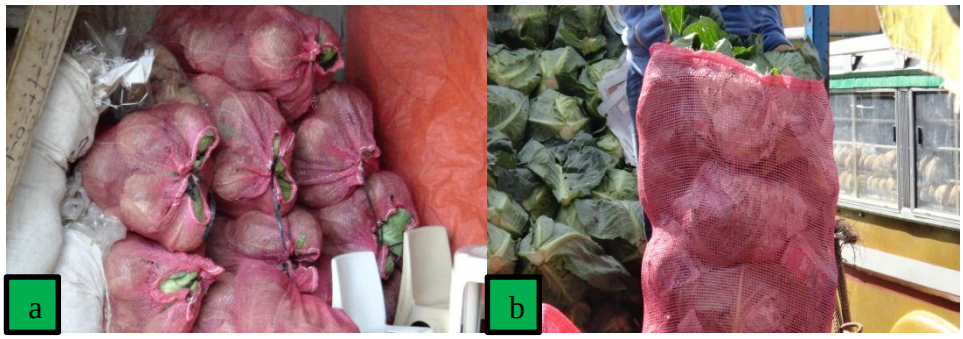

Figure 6(a-b). Use of Red bag as a packaging practice at LT Trading Post

Table 15 shows the Cabbage weight loss in Red bag after 3 days and 7 days. The weight loss after 3 days is 36.51% and 48.68% after 7 days. It was observed that there is a high weight loss in using red bag as packaging material for cabbage because of postharvest diseases, insects and water loss.

Table 15. Weight loss using red bag

Replicate	Initial weight	After 3 days		After 7 days	
		FW	%WL	FW	%WL
R1	4800g	2650g	44.79%	2500g	47.92%
R2	4950g	3060g	38.18%	2850g	42.42%
R3	5400g	2550g	52.78%	2450g	54.63%

Table 16 shows that the incidence after 3 days and 7 days are both 50% with a mean 16.67%. The severity after 3 days and 7 days are both 3.50% with a mean 1.67%. This indicates that using Red bag can minimize the growth of postharvest diseases.

Table 16. Incidence and severity of red bag

Replicate	**After 3 days**		**After 7 days**	
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
1	33.33	1.33	33.33	1.33
2	16.67	1.17	0	1
3	0	1	16.67	1.17
Total	50	3.5	50	3.5
Mean	**16.67**	**1.67**	**16.67**	**1.67**

SUMMARY, CONCLUSION AND RECCOMENDATION

Summary

This research aimed to evaluate the effect of packaging practices at La Trinidad Trading Post on the disease incidence and severity of Cabbage (*Brassica oleracea* var. *pekinensis*) and to identify the postharvest diseases associated with these packaging practices.

Results of the study revealed that there were no significant differences between treatments in terms of disease severity on the packaging materials which were the polyethylene plastic bag without holes and polyethylene plastic without holes and also the unwrap, half wrap and whole wrap practice being done on cabbage at La Trinidad trading post.

The postharvest diseases observed associated with the packaging practices was bacterial soft rot caused by *Pectobacterium carotovorum*. This indicates that the very rampant or common disease of cabbage is soft rot due to accumulation of moisture in the polyethylene plastic bag and also due to insect damage and improper handling.

Conclusion

Based on the results, both plastic without and with holes can be used in packaging the Cabbage and also both unwrap, half wrap and whole wrap can be used in wrapping the crop.

Recommendation

In relation to packaging, it is recommended that polyethylene plastic bag without and with holes could be used to contain the product. It is also recommended to use half wrap and whole wrap in wrapping the cabbage with newspaper.

It is recommended further that studies will be conducted on the evaluation of wrapping the cabbage.

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