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EVALUATION OF DIFFERENT PAPER AS BAGGING MATERIAL FOR MANGO FRUITS

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ABSTRACT

The influence of different bagging materials on yield and quality of 'Carabao' mango fruits were evaluated at different fruiting seasons (1998–2001). Different bagging materials included brown paper bag, thin waxy magazine, thick waxy magazine, yellow page telephone directory, imported and local newspapers. Fruits were bagged at 47 to 57 days after flower induction (DAFI).

Significant effects of bagging is shown on high recovery of marketable fruits over the unbagged. Imported newspaper followed by thin and thick waxy magazines gave the highest marketable yields in different seasons with an average of 13.92, 13.01 and 12.42 kgs, respectively. Brown paper bags (17.74 kg.) and local newspaper with lorsban impregnated plastic strips (13.09 kg.) were also promising. However, results were obtained only for one trial and should be verified. Number and weight of fruits retained at harvest did not vary significantly among bagged fruits. Unbagged fruits gave the lowest yield of marketable and non-marketable fruits.

Fruit bagging, using different paper materials resulted in lower insect and disease damage. However, it did not provide complete protection on developing fruits. Thick waxy magazine significantly prevented fruit fly damage with infestation ranging from 0 to less than 1%.

Bagged and unbagged fruits showed no significant difference on the external (except in peel color at harvest) and internal qualities of mango fruits. Peel color of bagged fruits is pale green while green for unbagged fruits. Furthermore, daily change in peel color of bagged and unbagged fruits showed no significant difference.

Imported newspaper, thick and thin waxy magazine were the most promising bagging materials for mango fruits in all seasons while brown paper bags and local newspapers are recommended only during dry season.

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RATIONALE

Mango *(Mangifera indica L.)* is one of the most important tropical fruits. It is also considered as an export winner crop of the Philippines and third important fruit crop in terms of area, volume and value. The "Carabao" mango, known internationally as "Manila Super Mango" is one of the world's best variety because of its delicate, sweet, aromatic and excellent flavor. The demand for this variety of mangoes is also great due to its superior quality, which command high price in the international markets. To maintain this quality, proper cultural management and crop protection practices are necessary. Production of quality fruits is however, hampered by insects and diseases. At present, pest control relies on the use of chemicals, which are not only expensive but also hazardous to human and the environment.

Bagging is one of the cultural practices in mango, which can improve fruit quality. It is a popular practice originating from Cebu, to protect fruits from damage of insects and diseases. Mango fruits are bagged at 55 to 60 days after flower induction (DAFI). The bag also serves as physical barrier to minimize problems related to mechanical injuries (scratches, abrasions, wind scars) and latex burn. While bagging of mangoes is well-known, not enough information is available on its effects on the external/internal characteristics of mango, the appropriate bagging materials and economics of its adaption. Hence, this study was conducted.

OBJECTIVES

This study aims to: 1) evaluate the yield and quality of mango fruits enclosed in different bagging materials and 2) determine the best and economical bagging materials for mango.

PLACE AND DURATION OF THE STUDY

The study was conducted at the mango orchard of the National Mango Research and Development Center, San Miguel Jordan Guimaras from 1998 to 2001.

REVIEW OF LITERATURE

Bagging is an important cultural management which reduces the number of pesticidal applications and produce fruits of better quality. Fruit rejects can be minimized from 15% to 60% if fruits were bagged (PCARRD, 1999). Bagged fruits are also free from damage caused by fiber discoloration, insects or diseases. The practice also minimizes the residual effects of chemicals (Ortega 1979). In addition, fruit bagging also reduces the number of pesticides spray without significant loss in fruit yield and quality of mango (Golez **et al.**, 2001).

Tang and Chang (1972) improved the bagging technique by using chemically impregnated bags. This completely prevented fruit fly attack. Ortega (1979) compared the efficiency of three bagging materials for 'Carabao' mango. These included perforated plastic bag, newsprint and blue paper match. The use of blue paper match and newsprint reduced disease damage on fruits by 17% and 28%, respectively. In addition, bagging significantly reduced insect damage by 12.6%. Blue paper match lowered insect damage by 3%. Plastic bags also reduced insect attack but resulted to softening of the fruits.

Bondad (1980) reported that newsprint is unsuitable for bagging since it was not durable. The best bagging materials recommended were: common waxy wallpaper followed by glycine bag. Plastic bag was durable but it made the fruits susceptible to pests and reduced external fruit quality. The best time to bag the fruits is at 55 days after flower induction. No advantage was obtained with close and open bags, but there was a slight problem when bags are open because they rendered fruits susceptible to scale insects and disease infection. Bags of different colors did not result to significant difference in control efficiency. The effect of bagging on internal quality of the fruit was inconsistent and insignificant in most treatments.

Amoy (1995) evaluated the different designs and kind of bagging materials against fruit fly infestation and its effect on fruit quality. These included paper cement bags, mesh cloth, white plastic bags, white and transparent bags lined with newspaper. Different bagging materials significantly controlled fruit fly infestation however, effects on fruit quality differed. In addition, no effect was observed on sugar content of the fruits. In terms of average weight and percent recovery of marketable fruits, paper cement bag and transparent or white plastic bags lined with newspapers recorded heavier and higher recovery. Sunscalding and rotting of fruits mostly occurred on fruits bagged with plastic bags.

METHODOLOGY

Test trees. Physiologically matured grafted trees of the 'Carabao' variety planted at a distance of 16 x 16 meters apart were induced to flower by spray application of 2.0 percent potassium nitrate (KNO3). Developing flowers were sprayed with insecticides and fungicides to protect them from major pests. Fruits that developed from these flowers were sprayed with foliar fertilizer to enhance growth and minimize fruit droppings.

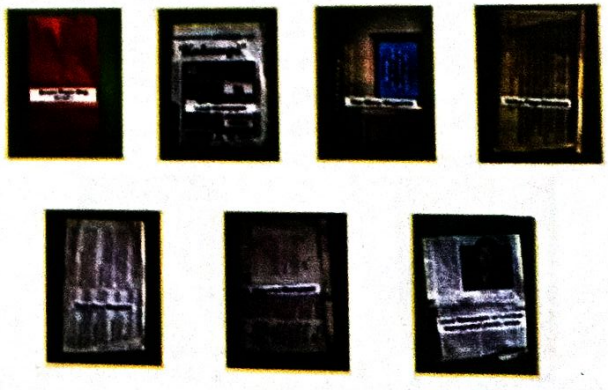
Bagging materials. Rectangular bags measuring 5.5 x 8.0 inches were prepared. The sides were folded and fastened with staple wire. The bottom portion was also secured by folding it in an inclined position to drain off excess water during rainy days. The bagging materials used were: a) brown paper bag, b) thin waxy magazine, c) thick waxy magazine, d) yellow page telephone directory, e) imported newspaper, f) local newspaper, g) local newspaper with lorsban impregnated plastic strips and h) control, unbagged fruits. For each material, 100 fruits were bagged except in the 1999 trial where only 50 fruits were utilized due to low fruit setting. The treatments consisting of different bagging materials were all placed in one tree and replicated 4 times except in the 1999 trial with only 3 replications because of limited number of fruits. Different bagging materials used from 1998 to 2001 is presented in Table 1 and Figure 1. The treatments varied with each season since some materials were not available or were replaced by better ones since these cannot withstand heavy rains.

Table 1. Bagging materials used in different seasons (1998 - 2001).

Treatment	Year			
	1998	1999	2000	2001
Brown paper bag	√	-	-	-
Thick waxy magazine	-	√	√	√
Thin waxy magazine	√	√	√	√
Yellow page telephone directory	-	√	-	-
Imported newspaper	√	-	√	√
Local newspaper	√	√	√	√
Local newspaper with Lorsban impregnated plastic strips (LIPS)	-	-	-	√
Control *(Unbagged)*	√	√	√	-

Note: Treatments were placed on one tree replicated 4 times except in 1999 trial where only 3 replications were done.

Fig. 1 Different bagging Materials



Procedures in bagging. At 35 days after flower induction, the trees were evaluated and those with 70 to 80 percent fruit set were selected and subjected to the different treatment. The fruits were bagged at 47 to 57 DAFI when they attained the "marble" size. Bagging was done with the aid of ladder and rope *(Figure 2)*. For small trees, the base of the ladder rest on the ground while the body leans on one side of the canopy. The ladder is fixed on the ground using ropes. For big trees, ropes were tied around the bagger's waist with one end of the rope tied to a sturdy branch. In this manner, the bagger can position himself anywhere in the canopy. Bagging was done from tree top to the bottom. During bagging only one fruit is enclosed per bag placed at the center, folding the openings to form a triangle and securely stapled *(Figure 3)*. Fruits with blemishes and deformities were not bagged.

Fig. 2 Bagging Fruits using ladder and rope.

Fig. 3 Steps in Bagging

1. Insert the fruit into a pre-formed bags (rectagular in shape 5.5" x 8")

2. Fold the opening

3. Staple the upper portion

4. Close-up of bagged fruit

Evaluation of bagging materials. Immediately after harvest, fruits were examined individually for the following:

Pest infestation

a. Insect damage. Insect pests observed in the fruits were mealy bugs and scale insects. Mealy bugs are whitish, cottony insects while scale insects are oval, sedentary and their bodies covered with transparent waxy material. The incidence of scale infestation was determined based on total number of infested fruits over the total fruits harvested. Some fruits exhibited damage from Cecid fly and Helopeltis bug. This damage is locally known as 'buti' or 'korikong'. The incidence of infestation was also recorded from newly harvested fruits. On the other hand, damage from fruit flies was exhibited by ovipositional punctures on the peel. The affected portions were dissected to check the damage before the incidence was recorded.

b. Disease damage. Incidence of scab and sooty molds were assessed on fruits at harvest. On the other hand, anthracnose and stem end rot were monitored 5 days after harvest and daily thereafter until 100 percent infection occurred.

Physical damage.

Other defects such as wind scar, latex stains, bioko fruits, cracking and other quality defects of the fruits at harvest were recorded.

Fruit Quality

a. External characteristics. Fruits were evaluated to determine the influence of bagging materials on peel color at harvest using a given scale. In addition, the daily change in peel color was determined using the UPLB-PHTRC rating scale. Fruit shape, peel color and texture were evaluated 8 days after harvest using National Seed Industry Council (NSIC) index for external evaluation of fruits.

b. Internal characteristics. Flesh color, texture, juiciness, aroma, fiber in flesh, total soluble solids (TSS°) were evaluated using the NSIC fruit internal evaluation index. Percent edible portion (%E.P.) was determined by dividing the weight of flesh over the weight of the whole fruit multiplied by 100. On the other hand, sweetness of the fruit was evaluated using a refractometer (° Brix).

c. Yield. At harvest the number of fruits retained per treatment was counted. These fruits were weighed and classified as to marketable (without blemishes or defects) or non-marketable. Marketable fruits were further classified as to: small (190-240g), medium (241-289g) and large (290g-up). Non-marketables (with defects) were classified as rejects and factors associated with their non-marketability were determined.

Economic analysis. Cost of material and yield per treatment were computed to determine the best bagging material at affordable cost. This was done by dividing the total cost of material per treatment over total yield (kg). This information presented the cost of bagging material per kilogram fruit.

The experiment was laid out in a randomized complete block design (RCBD) replicated four times except in 1999 trial with only 3 replications. All data were analyzed using the analysis of variance (ANOVA). Significant differences among treatment means were determined using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSIONS

Pests Incidence

Insect damage. The insect pests observed on fruits at harvest were scale insects, mealybugs, cecid fly, helopeltis bug and fruit fly.

During the first and second year trials, incidence of scale insects and mealy bugs was low, with not more than 1.40% among the treatments, (Table 2a.) However, on the succeeding years, the incidence of infestation increased with the highest recorded on imported newspaper (6.05%) and thick waxy magazine (8.73%) for 2000 and 2001, respectively. LIPS incorporated inside newspaper bags gave the lowest scale and mealy bug infestations (5.11%) compared to the rest of the treatments. Infestations among different bagging materials varied per season. Unbagged fruits showed low incidence of infestation (0 to 0.32%) since very few fruits were retained at harvest.

Table 2a. Incidence of scale insect and mealybug infestations among harvested fruits (1998 - 2001).

Treatment	Percent infestation[1]			
	1998	1999	2000	2001
Brown paper bag	0.55^{bc}	-	-	-
Thick waxy magazine	-	0	3.99^{b}	8.73^{a}
Thin waxy magazine	1.40^{a}	0	4.18^{b}	5.91^{b}
Yellow page telephone directory	-	0	-	-
Imported newspaper	0.80^{b}	-	6.05^{a}	5.68^{b}
Local newspaper	0.37^{c}	0	3.18^{b}	5.56^{b}
Local newspaper with Lorsban impregnated plastic strips (LIPS)	-	-	-	5.11^{b}
Control (*Unbagged*)	0.32^{c}	0	0^{c}	-

[1] Data transformed to square root of (x+0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Cecid fly and helopeltis damage were not observed during the 1998 dry season harvest, (Table 2b). However, the incidence was significantly higher on unbagged fruits in 1999 and 2000 trials with 8.33 and 6.72%, respectively. Damage from these pests varied per season but did not differ significantly among bagging materials. Infestations ranged from 1.1 to 5.55%.

Unbagged fruits significantly showed the highest fruit fly infestation of 12.50%. Fruits bagged with local newspaper had the highest incidence (7.7%) in 1999. No significant difference was noted in 2000, however in 2001 incidence was high on imported newspaper and low on thick waxy magazine with 3.76 and 0.80 %, respectively. Result indicated that bagging of fruits reduced incidence of fruit fly infestation.

Table 2b. Incidence of Cecid fly/Helopeltis bug and Fruit fly infestations among harvested fruits (1999 - 2001).

Treatment	Percent Infestation[1]					
	Cecid Fly/Helopeltis Bug			Fruit Fly		
	1999	2000	2001	1999	2000	2001
Brown paper bag	-	-	-	-	-	-
Thick waxy magazine	1.11^{e}	4.28^{b}	3.93^{a}	0^{e}	0.96^{b}	0.80^{e}
Thin waxy magazine	5.55^{b}	1.76^{c}	2.53^{b}	1.75^{cd}	0.67^{b}	2.59^{b}
Yellow page telephone directory	1.38^{c}	-	-	2.77^{c}	-	-
Imported newspaper	-	3.42^{b}	2.16^{b}	-	0.62^{b}	3.76^{a}
Local newspaper	1.75^{c}	3.78^{b}	3.39^{a}	7.77^{b}	0.54^{b}	1.83^{c}
Local newspaper with Lorsban impregnated plastic strips (LIPS)	-	-	2.16^{b}	-	-	1.31^{d}
Control (*Unbagged*)	8.33^{a}	6.72^{a}	-	12.5^{a}	3.58^{a}	-

[1] Data transformed to square root of (x+0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Table 3a. Incidence of scab infection among harvested fruits (1998 - 2001).

Treatment	Percent Infection[1]			
	1998	1999	2000	2001
Brown paper bag	0	-	-	-
Thick waxy magazine	-	0^{c}	68.38^{ab}	66.31
Thin waxy magazine	0	2.77^{b}	56.84^{b}	55.08
Yellow page telephone directory	-	4.16^{a}	-	-
Imported newspaper	0	-	60.40^{b}	59.11
Local newspaper	0	0^{c}	52.95^{b}	70.04
Local newspaper with Lorsban impregnated plastic strips (LIPS)	-	-	-	64.98
Control (*Unbagged*)	0	4.16^{a}	77.66^{a}	-

[1] Data transformed to square root of (x+0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Disease damage. Scab infection was not observed during the 1998 dry season harvest, (Table 3a). However, on the succeeding years (1999-2001), the disease was evident on bagged and unbagged fruits. Unbagged fruits and local newspaper gave the highest incidence of the disease, with 77.66 and 70.04%, respectively. Scab infection on bagged fruits did not differ with the materials used in the different seasons. Although the incidence of scab was high on bagged fruits, the extent of damage on the fruit surface was low compared to unbagged fruits.

Similar trend was observed on the incidence of sooty mold in all trials, (Table 3b). Sooty mold incidence among bagged fruits ranged from 1.38 to 21.19% with the lowest on yellow page directory while the highest on local newspaper. Unbagged fruits significantly gave higher incidence of sooty mold with 4.17 and 59.90% for 1999 and 2000, respectively.

Anthracnose incidence and severity of infection was evaluated 5 to 9 days after harvest (DAH). Damage on unbagged fruits at 5 to 6 days after harvest was significantly highest compared with bagged fruits (Table 4a). However, at 7 DAH, the incidence was comparable among the thick and thin waxy magazines.

The result showed no significant difference among treatments as the disease advances to 8 to 9 days after harvest. Disease incidence monitored at different intervals, showed no significant difference among bagged fruits with different papers. Severity of infection was significantly high on unbagged compared to bagged fruits. These results were confirmed on the succeeding year, at 6 to 9 DAH (Table 4b). Disease development monitored at different intervals was not significant among treatments except for severity of damage. Fruits bagged with local newspaper, recorded the highest infection but this result was comparable to the rest of the bagging materials.

Anthracnose infection monitored at different intervals were consistently significant on unbagged fruits with the highest rating of 7.38 (46 to 55% damage on fruit surface). On the other hand, severity rating among bagging materials observed in all seasons ranged from 1.15 to 4.70 (1 to 25% damage on the fruit surface).

Table 3b. Incidence of sooty mold infection among harvested fruits (1998 - 2001).

Treatment	Percent Infection[1]			
	1998	1999	2000	2001
Brown paper bag	0	-	-	-
Thick waxy magazine	-	0^{e}	8.68^{bc}	13.42^{c}
Thin waxy magazine	0	0^{e}	5.65^{c}	11.22^{d}
Yellow page telephone directory	-	1.38^{b}	-	-
Imported newspaper	0	-	6.34^{c}	16.73^{b}
Local newspaper	0	0^{e}	9.49^{b}	21.19^{a}
Local newspaper with Lorsban impregnated plastic strips (LIPS)	-	-	-	9.06^{c}
Control (*Unbagged*)	0	4.17^{a}	59.90^{a}	-

[1] Data transformed to square root of (x+0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Table 4a. Incidence and severity of anthracnose infection on mango fruits stored at ambient temperature (2000).

Treatment	5 DAH		6 DAH		7 DAH		8 DAH		9 DAH	
	Incidence	*Severity*[1]	*Incidence*	*Severity*	*Incidence*	*Severity*	*Incidence*	*Severity*	*Incidence*	*Severity*
Thick waxy magazine	25.00[b]	1.25[b]	52.50[b]	1.90[b]	72.50[ab]	2.32[b]	92.50	3.37[b]	95.00	4.45[b]
Thin waxy magazine	30.00[b]	1.35[b]	55.00[b]	1.95[b]	70.00[ab]	2.50[b]	95.00	3.65[b]	95.00	4.70[b]
Imported newspaper	15.00[b]	1.15[b]	55.00[b]	1.75[b]	62.50[b]	2.30[b]	92.50	3.42[b]	95.00	4.25[b]
Local newspaper	17.50[b]	1.25[b]	50.00[b]	1.75[b]	65.00[b]	2.15[b]	95.00	3.30[b]	100.00	4.55[b]
Control	82.50[a]	2.60[a]	92.50[a]	3.62[a]	95.00[a]	4.55[a]	100.00	5.90[a]	100.00	7.38[a]

[1]Disease severity was evaluated using the following scale:

1 - no infection
2 - presence of 1-5% lesions per fruit
3 - presence of 6-15% lesions per fruit
4 - presence of 16-25% lesions per fruit
5 - presence of 26-35% lesions per fruit
6 - presence of 36 – 45% lesions per fruit
7 - presence of 46 – 55% lesions per fruit
8 - presence of 56-65% lesions per fruit
9 - presence of 66% and above lesions per fruit

In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.
DAH - day after harvest

Table 4b. Incidence and severity of anthracnose infection on mango fruits stored at ambient temperature (2001).

Treatment	6 DAH		7 DAH		8 DAH		9 DAH	
	Incidence	*Severity*[1]	*Incidence*	*Severity*[1]	*Incidence*	*Severity*[1]	*Incidence*	*Severity*[1]
Thick waxy magazine	40.00	1.45[ab]	77.50	2.03[ab]	97.50	3.20[ab]	100.00	3.05[b]
Thin waxy magazine	27.50	1.33[ab]	70.00	1.80[b]	97.50	2.55[b]	100.00	3.60[ab]
Imported newspaper	30.00	1.35[ab]	67.50	1.93[b]	92.50	2.80[ab]	97.50	3.63[ab]
Local newspaper	45.00	1.68[a]	82.50	2.53[a]	95.00	3.95[a]	100.00	4.25[a]
Local newspaper w/ Lorsban impregnated plastic strips	25.00	1.28[b]	62.50	1.88[b]	97.50	2.90[ab]	97.50	3.53[ab]

[1]Disease severity was evaluated using the following scale:

1 - no infection
2 - presence of 1-5% lesions per fruit
3 - presence of 6-15% lesions per fruit
4 - presence of 16-25% lesions per fruit
5 - presence of 26-35% lesions per fruit
6 - presence of 36 – 45% lesions per fruit
7 - presence of 46 – 55% lesions per fruit
8 - presence of 56-65% lesions per fruit
9 - presence of 66% and above lesions per fruit

In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.
DAH - days after harvest

Stem end root was not evident during the storage period and incidence was negligible among treatments.

Fruit Quality

External characteristics. At harvest, fruits were evaluated for peel color using a 1-5 scale (1- pale green, 3- green and 5- dark green). Fruits bagged with different paper materials were pale green compared to unbagged which were green (Table 5a). No significant difference in peel color was also observed among bagging materials used. The daily change in peel color, one to eight days after harvest were also evaluated (Table 5b). Results showed that daily change in color of bagged and unbagged fruits have no significant difference among treatments in all trials. The effects of bagging materials on shape, peel color and texture were also evaluated when fruits ripened. Fruit shape was rated fairly to well formed with yellow to yellow orange peel. The texture was intermediate to smooth and leathery (Table 5c). No significant difference was observe on the shape, peel color and texture of fruits bagged with different paper materials eight days after harvest.

Internal characteristics. The internal characteristics of fruits bagged with different paper materials did not vary with each other (Table 5d). These included flesh color (yellow to yellow orange), juiciness, aroma, fiber in flesh and edible portion. Flesh texture was found tender/melting for both seasons using brown paper bag and thin waxy magazine. However, result was comparable to unbagged fruits. Total soluble solid was high during dry than rainy season trial. Imported newspaper showed the highest TSS° with 21.25 Brix° but result was comparable with other treatments except for the yellow page telephone directory which recorded the lowest reading (10.30 Brix°). High percentage edible portion was obtained for all treatments in both seasons ranging from 76.62 to79.49%.

Table 5a. Peel color at harvest (1998 - 2001).

Treatment	Peel color			
	1998	1999	2000	2001
Brown paper bag	1.3[b]	-	-	-
Thick waxy magazine	-	1.20[b]	1.5[b]	1.15
Thin waxy magazine	1.35[b]	1.13[b]	1.40[b]	1.0
Yellow page telephone directory	-	1.33[b]	-	-
Imported newspaper	1.15[b]	-	1.45[b]	1.05
Local newspaper	1.3[b]	1.23[b]	1.55[b]	1.10
Local newspaper with Lorsban impregnated plastic strips (LIPS)	-	-	-	1.05
Control (*Unbagged*)	3.53[a]	3.40[a]	3.60[a]	-

Peel color was evaluated at harvest using the following scale:
1 - pale green 3 - green; 5 - dark green

In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Table 5b. External characteristics of mango fruits enclosed with different bagging materials 8 days after harvest (1998 - 1999).

Treatment	Shape		Peel color		Peel texture	
	1998	1999	1998	1999	1998	1999
Brown paper bag	4.00	-	4.25^{ab}	-	4.00	-
Thick waxy magazine	-	3.33	-	3.67^{ab}	-	3.00
Thin waxy magazine	4.00	3.00	3.50^{bc}	3.83^{ab}	3.50	4.00
Yellow page telephone directory	-	2.75	-	4.00^{a}	-	3.67
Imported newspaper	3.50	-	3.75^{ab}	-	3.88	-
Local newspaper	3.50	2.67	4.50^{a}	3.50^{ab}	3.50	2.83
Control	3.50	3.33	2.75^{c}	3.00^{b}	3.50	3.33

External characteristics were evaluated using the following scale:

Fruit shape = 1 - off size, irregular in shape, 2-3 - fairly formed , 4-5 - well formed typical of 'Carabao' varitey

Peel color = 1 - light yellow, 2 - 3 - yellow , 4-5 - yellow orange

Peel texture = 1 - rough , 2-3 - intermediate, 4- 5 - smooth and leathery

In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Table 5c. Daily change in peel color of mango fruits after harvest (2000-2001).

Treatment	Peel Color Change													
	1 DAH		2 DAH		3 DAH		4 DAH		5 DAH		6 DAH		7 DAH		8 DAH	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Thick waxy magazine	1.78	1.23	2.06	1.50	2.65	2.05	3.15	2.80	4.15	3.63	5.30	4.20	5.68	5.40	5.88	6.00
Thin waxy magazine	1.62	1.05	1.92	1.30	2.73	1.83	3.48	2.48	4.32	3.20	5.30	3.93	5.68	4.93	5.68	5.93
Imported newspaper	1.75	1.08	2.05	1.15	2.62	1.58	3.38	2.40	4.30	3.05	5.25	3.90	5.60	5.13	5.65	5.78
Local newspaper	1.82	1.13	2.12	1.45	2.70	2.05	3.52	2.88	4.17	3.63	5.28	4.35	5.60	5.08	5.75	6.00
Local newspaper w/ Lorsban impregnated plastic strips	-	1.08	-	1.30	-	2.05	-	2.78		3.65	-	4.55	-	5.60	-	6.00
Control	1.73	-	2.01	-	2.43	-	3.10	-	4.25	-	4.98	-	5.12	-	5.35	-

Daily change in peel color was evaluated using the following scales:

1- 100% green, 2 - 75% green, 25% yellow (traces of yellow), 3 - 60% green, 40% yellow (more green than yellow), 4 - 40% green, 60% yellow (more yellow than green), 5 - 25% green, 75% yellow (traces of green), 6 - 100% yellow.

In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Table 5d. Internal characteristics of mango fruit s enclosed with different bagging materials (1998-1999).

Treatment	Flesh color		Flesh texture		Flesh juiciness		Flesh aroma		Fiber in flesh		TSS (Brix^{0})		Edible Portion	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Brown paper bag	4.75	-	8.75^{a}	-	4.00	-	4.00	-	4.00	-	18.25^{a}	-	78.88	-
Thick waxy magazine	-	4.00^{ab}	-	7.17^{ab}	-	4.00	-	4.17	-	3.00	-	13.50^{a}	-	79.49
Thin waxy magazine	4.13	4.50^{a}	7.25^{bc}	7.50^{a}	3.38	4.00	3.75	3.83	4.25	3.00	18.50^{a}	12.93^{ab}	78.98	78.57
Yellow page telephone directory	-	3.00^{c}	-	5.00^{b}	-	4.50	-	4.17	-	3.00	-	10.30^{c}	-	78.38
Imported newspaper	4.75	-	6.75^{bc}	-	4.00	-	3.25	-	4.00	-	21.25^{a}	-	77.42	-
Local newspaper	4.50	3.00^{bc}	6.50^{c}	4.83^{b}	4.25	3.83	4.00	3.83	4.00	3.50	19.75^{ab}	12.27^{b}	76.62	77.85
Control	4.25	4.00^{ab}	8.00^{ab}	5.50^{ab}	3.50	3.50	3.50	3.50	4.50	3.50	19.38^{ab}	12.27^{b}	79.00	78.63

Evaluations for the internal characteristics of fruits using the following scales:

Flesh color	Flesh texture	Juiciness	Aroma	Fiber in flesh	Percent edible portion
1-2 light yellow	1 - 3 coarse and soggy	1-3 dry	1 - 3 strong	1 - abundant	High (>76 %)
3-4 yellow	4 - 6 intermediate	4-5 moderate	4- 5 mild	2 -3 moderate	Intermediate (70-75%)
5 - yellow orange	7 - 10 tender/melting	1-3 - juicy	1 -3 weak	4-5 scanty to none	Low (<20%)

In column, means having similar letter superscripts are not significantly different at 5% level using DMRT.

Bagging of fruits using different paper materials have no influence on the external and internal quality of mango fruits since rating values did not differ significantly among treatments in most parameters used. The difference in peel color at harvest was however, evident since bagged fruits were pale green while unbagged were green. Ortega (1979) noted that total acidity between bagged and unbagged fruits showed no difference. Her findings is similar to this experiment. Bondad (1980) claimed that effects of bagging on internal quality of the fruit was inconsistent in some cases and insignificant in most treatments. Lizada and Bugante (1996), also showed that no significant differences in the TSS° between bagged and unbagged mango fruits. Furthermore, Hoffman et. al. (1997), revealed that fruit mass, flesh color, total soluble solids, acidity and eating quality were generally not affected by bagging, instead fruit quality can be improved through disease reduction. Results of this study showed that fruit bagging affects peel color of mango fruits but not its eating quality. Incidence of insect infestation such as cecid fly and fruit fly was reduced. Thick waxy magazine consistently reduced fruit fly infestation with damage ranging from 0 to less than 1% in all trials. Disease incidence was also minimized in some season but not in all seasons, specially during high rainfall.

Physical defects. Bioko, fruit cracking, early ripening, wind scar and latex stains were commonly observed among non-marketable fruits. The percent incidence was evaluated as shown in Table 6. Occurrence of bioko fruits on bagged and unbagged fruits during dry and rainy seasons were inconsistent. Incidence of bioko ranged from 2.36 to 13.47%.

Not more than 5.5% fruit cracking was recorded in all treatments during dry season (1998), except for thick and thin waxy magazines where damage was not observed. On the succeeding years, incidence of fruit cracking among bagging materials ranged between 1.31 to 5.75%. High incidence of fruit cracking was monitored during rainy season harvest.

Unbagged fruits significantly showed the highest fruit cracking incidence of 6.71%.

Table 6. Some defects observed among harvested fruits.

Treatment	% Incidence[1]												
	Bioko				Fruit Cracks			Early ripening			Wind Scar		Latex Stains
	1998	1999	2000	2001	1999	2000	2001	1998	2000	2001	1998	2001	2000
Brown paper bag	6.80^{c}	-	-	-	-	-	-	1.68^{ab}	-	-	1.04^{b}	-	
Thick waxy magazine	-	11.66^{b}	4.96^{c}	9.71^{a}	0^{d}	3.79^{c}	2.31^{b}	-	0.84^{c}	2.27^{c}	-	5.59^{a}	8.01^{b}
Thin waxy magazine	5.77^{d}	5.72^{c}	8.37^{b}	7.22^{b}	0^{d}	5.75^{b}	4.03^{a}	2.13^{a}	3.37^{a}	5.22^{a}	0.99^{b}	2.89^{c}	8.46^{b}
Yellow page telephone directory	-	13.47^{a}	-	-	2.77^{c}	-	-	-	-		-	-	-
Imported newspaper	6.65^{c}	-	3.94^{c}	2.36^{c}	-	4.30^{c}	2.68^{b}	1.25^{b}	1.87^{b}	5.19^{a}	0.43^{c}	4.36^{b}	6.24^{c}
Local newspaper	8.09^{b}	5.26^{c}	10.18^{a}	3.61^{c}	5.55^{a}	4.31^{c}	1.31^{c}	1.26^{b}	1.18^{c}	1.90^{c}	0.94^{b}	3.56^{c}	6.86^{c}
Local newspaper w/ Lorsban impregnated plastic strips	-	-	-	10.45^{a}	-	-	3.55^{a}	-	-	3.57^{b}	-	5.42^{a}	-
Control	9.73^{a}	0^{d}	1.66^{d}	-	4.17^{b}	6.71^{a}	-	1.57^{ab}	0^{d}	-	10.02^{a}	-	12.55^{a}

Bioko - small deformed fruits, usually round shape
Cracking - fruits that split open, cracks usually longitudinal, starting from shoulder to apex
Wind scars - bruises observed on skin as result of fruit contact between leaves and branches
Latex stain - skin burning due to exudates (latex)

[1]Data transformed to square root of (x + 0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT

Early ripening of fruits at harvest was significantly consistent in thin waxy magazine for 3 seasons compared to the rest of the treatments.

Wind scar of 10.02% was significantly highest on unbagged fruits compared to bagged. Thin waxy magazine and local newspaper with LIPS significantly gave the highest incidence of wind scar compared to other treatments with 5.59 and 5.42% respectively.

Latex stains at harvest was significantly higher on unbagged fruits (12.55%). The damage among bagged fruits ranged between 6.24 to 8.46% with highest on thin waxy magazine and lowest on imported newspaper.

Yield

Fruit yield and classification of marketable fruits

In 1998, fruits harvested from 100 tagged panicles were significantly higher on brown paper bag and thin waxy magazine while lowest on imported newspaper with 74.25, 73.25 and 56.75 pieces, respectively, (Table 7a). Similar trend was observed on the total weight of harvested fruits. The sizes of marketable fruits were mostly medium in most treatments. Brown paper bag has the most number of large and small fruits while thin waxy magazine with medium fruits. Least number of small fruits was observed on imported newspaper. Brown paper bag showed the highest total number of marketable fruits but in terms of total weight this was comparable with thin waxy magazine. Unbagged fruits had the least number and weight of marketable fruits.

In 1999, the occurrence of high rainfall (812.44 mm) resulted to decrease in yield for all treatments. Nonetheless, thick waxy magazine recorded the highest fruit retention of 23 pieces, followed by thin waxy magazine with 19.33 pieces.

Table 7a. Fruit yield and classification.

Treatment/Year	Total fruits harvested (pcs)	Weight (kg)	Marketable[1]							
			Large (290 g-up)		Medium (241-289g)		Small (190-240g)		Total	
			(pcs)	(kg)	(pcs)	(kg)	(pcs)	(kg)	(pcs)	(kg)
CY 1998										
Brown paper bag	74.25^{a}	18.99^{a}	19.50^{a}	6.21^{a}	28.50^{b}	7.47^{b}	18.75^{a}	4.06^{a}	66.75^{a}	17.74^{a}
Thin waxy magazine	73.25^{a}	19.04^{a}	17.75^{c}	5.73^{b}	31.25^{a}	8.17^{a}	16.75^{c}	3.77^{a}	65.75^{b}	17.67^{a}
Imported newspaper	56.75^{d}	14.28^{c}	18.75^{b}	6.08^{ab}	21.50^{c}	4.94^{c}	11.50^{c}	2.48^{b}	51.75^{d}	14.27^{c}
Local Newspaper	69.25^{b}	17.56^{b}	18.50^{b}	5.90^{ab}	25.50^{c}	6.66^{c}	17.75^{b}	3.82^{a}	61.75^{c}	16.38^{b}
Control *(Unbagged)*	59.50^{c}	14.70^{c}	12.50^{d}	3.97^{c}	22.25^{d}	5.77^{d}	13.50^{d}	2.83^{b}	48.25^{e}	12.56^{d}
CY 1999										
Thick waxy magazine	23.00^{a}	5.77^{a}	5.67^{a}	1.81^{a}	9.67^{a}	2.56^{a}	4.67^{ab}	1.00^{ab}	20.00^{a}	5.38^{a}
Thin waxy magazine	19.33^{b}	5.00^{b}	6.00^{a}	1.92^{a}	6.33^{ab}	1.67^{ab}	5.67^{a}	1.22^{a}	18.00^{b}	4.81^{b}
Yellow page telephone directory	14.67^{d}	3.70^{c}	5.00^{a}	1.60^{ab}	3.33^{b}	0.88^{b}	4.33^{b}	0.93^{ab}	12.67^{c}	3.41^{c}
Local newspaper	16.33^{c}	3.94^{c}	4.00^{a}	1.28^{b}	4.00^{ab}	1.06^{b}	5.00^{ab}	1.07^{a}	13.00^{c}	3.41^{c}
Control *(Unbagged)*	7.00^{e}	1.90^{d}	1.33^{b}	0.43^{c}	1.67^{b}	0.44^{b}	3.00^{c}	0.64^{b}	6.00^{d}	1.51^{d}

[1]Data transformed to square root of (x + 0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT

Large marketable fruits showed no significant difference among paper materials used. Thick and thin waxy magazines and local newspaper produced more medium fruits. While number of small fruits was high on thin waxy magazine but results were comparable to the rest of the treatments except the yellow page telephone directory and control. Based on the total number and weight of marketable fruits, thick waxy magazine gave the highest, followed by thin waxy magazine while yellow page telephone directory and local newspaper produced similar results. Since there were few fruits retained at harvest, unbagged fruits had the lowest marketable yield both in number and weight.

For the year 2000 (Table 7b), the number and weight of fruits retained at harvest did not vary significantly among bagging materials used except the control. More large fruits were observed on thick waxy magazine, imported and local newspapers. The highest number of medium fruits was recorded on imported newspaper followed by thin waxy magazine with 19.50 and 18.25 pieces, respectively. Thick waxy magazine and local newspaper had comparable results. The number of small fruits was comparable among bagging materials except the control. Total marketable yield has no significant difference among the bagging materials used. Control treatment gave the lowest yield which was attributed to low fruit retention at harvest.

In the final trial (2001), no significant difference was observed on the number and weight of fruits retained per treatment. Imported newspaper significantly has more number of large fruits (20.25 pcs.) while thick waxy magazine the lowest (12 pcs.). Local newspaper with LIPS significantly gave the lowest number of medium fruits (14.75 pcs.) but this was comparable to the rest of bagging materials except for imported newspaper (24.25 pcs). Thick waxy magazine significantly had the highest number of small fruits (18.25 pcs.) while imported newspaper the lowest (9.75 pcs). No significant difference in total marketable yield was observed among treatments.

Table 7b. Continuation . . . . .

Treatment/Year	Total fruits harvested (pcs)	Weight (kg)	Marketable[1] Large (290 g-up)		Medium (241-289g)		Small (190-240g)		Total	
			(pcs)	(kg)	(pcs)	(kg)	(pcs)	(kg)	(pcs)	(kg)
CY 2000										
Thick waxy magazine	51.50^{a}	14.14^{a}	19.50^{a}	6.24^{a}	17.25^{c}	4.57^{b}	9.50^{b}	2.04^{a}	46.25^{a}	12.85^{a}
Thin waxy magazine	48.75^{a}	12.70^{a}	12.25^{bc}	3.92^{bc}	18.25^{b}	4.84^{ab}	10.00^{ab}	2.15^{a}	40.50^{a}	10.91^{a}
Imported newspaper	48.50^{a}	13.22^{a}	16.00^{ab}	5.12^{ab}	19.50^{a}	5.17^{a}	8.50^{c}	2.22^{a}	44.00^{a}	12.51^{a}
Local newspaper	50.00^{a}	13.26^{a}	15.25^{ab}	4.88^{ab}	16.75^{c}	4.44^{b}	11.00^{a}	2.37^{a}	43.00^{a}	11.68^{a}
Control *(Unbagged)*	11.50^{b}	3.53^{b}	6.00^{c}	1.92^{c}	3.00^{d}	0.79^{c}	1.00^{d}	0.22^{b}	10.00^{b}	2.93^{b}
CY 2001										
Thick waxy magazine	60.25	14.99	12.00^{d}	3.84^{d}	22.25^{ab}	5.89^{ab}	18.25^{a}	3.92^{a}	52.50	13.65
Thin waxy magazine	59.50	15.61	18.00^{b}	5.76^{b}	20.00^{ab}	5.29^{ab}	13.00^{c}	2.79^{c}	51.00	13.85
Imported newspaper	62.00	16.80	20.25^{a}	6.48^{a}	24.25^{a}	6.42^{a}	9.75^{d}	2.09^{d}	54.25	15.00
Local newspaper	52.50	13.87	15.75^{c}	5.04^{c}	19.50^{ab}	5.16^{ab}	13.00^{c}	2.77^{c}	48.25	12.97
Local newspaper w/ Lorsban impregnated plastic strips	57.25	14.76	17.50^{b}	5.75^{b}	14.75^{b}	3.90^{b}	16.50^{b}	3.55^{b}	48.75	13.09

[1]Data transformed to square root of (x + 0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT

The number of non -marketable fruits did not differ significantly among bagging materials used except for local newspaper. Weight of non-marketable fruits bagged with imported, local newspaper with LIPS and thin waxy magazine were comparable with each other except for thick waxy magazine and local newspaper.

This result showed that different bagging materials has no significant effect on size of mango fruits. However, significant effect of bagging is shown in the high recovery of marketable fruits over the unbagged. The number and weight of fruits retained at harvest did not vary significantly among bagging materials in most trials. Unbagged fruits gave the lowest yield for both marketable and non-marketable fruits, again this was attributed to low fruit retention at harvest. The quality of fruit subjected to the different treatments and season are presented in Figure 4.

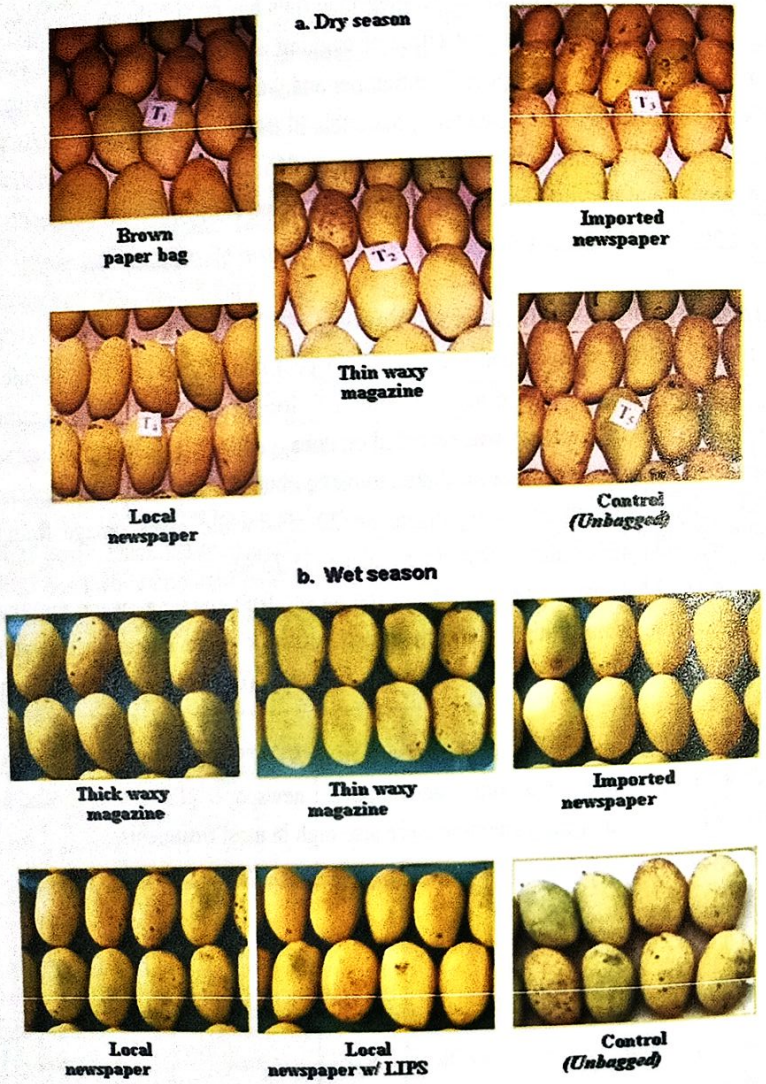
Non-marketable fruits and causes of damage

Imported newspaper recorded the lowest (5 pcs) non-marketable fruits while the rest of the papers did not vary in number with 7.5 fruits each, (Table 8a). Significant number of non-marketable fruits was recorded on unbagged fruits (11.25 pcs). The causes of non-marketability in 1998 were attributed to bioko obtained from imported newspaper (79.38%), early ripening in thin waxy magazine (20.25%) while insect damage from thin waxy magazine (11.46%) and imported newspaper (11.25%).

In 1999 harvest, bioko, insect infestation and fruit cracking were the causes of non-marketable fruits with significant effects on thick waxy magazine and yellow page telephone directory (88.89%), thin waxy magazine (66.67%) and local newspaper (23.75%), respectively.

In 2000 trial, highest insect infestation of 91.67% for non-marketable fruits were recorded from unbagged fruits and imported newspaper (Table 8b). Bioko, fruit cracking , wind scars and early ripening were also high in most treatments.

Figure 4 Quality of fruits subjected to the different treatment and seasons



ig. 4. Quality of fruits subjected to the different treatment and seasons.

Table 8a. Fruit yield and classification.

Treatment/Year	Total fruits harvested (pcs)	Weight (kg)	Non-marketable[1] (pcs)	Non-marketable[1] (kg)	Causes of non-marketable (%)[1] Insects*	Bioko	Fruit Cracking	Wind scars	Latex stains	Ripening
CY 1998										
Brown paper bag	74.25^{a}	18.99^{a}	7.50^{b}	1.25^{b}	6.25^{b}	66.96^{c}	0	0	0	16.50^{b}
Thin waxy magazine	73.25^{a}	19.04^{a}	7.50^{b}	1.37^{b}	11.46^{a}	57.79^{d}	0	0	0	20.25^{a}
Imported newspaper	56.75^{d}	14.28^{c}	5.00^{c}	0.78^{c}	11.25^{a}	79.38^{a}	0	0	0	11.25^{c}
Local newspaper	69.25^{b}	17.56^{b}	7.50^{b}	1.18^{b}	4.17^{bc}	77.50^{b}	0	0	0	10.50^{c}
Control *(Unbagged)*	59.50^{c}	14.70^{c}	11.25^{a}	2.14^{a}	1.67^{c}	55.84^{c}	0	0	0	8.25^{c}
CY 1999										
Thick waxy magazine	23.00^{a}	5.77^{a}	3.00^{a}	0.39^{ab}	11.11^{d}	88.89^{a}	0^{c}	0	0	0
Thin waxy magazine	19.33^{b}	5.00^{b}	1.33^{bc}	0.19^{b}	66.67^{a}	55.56^{b}	0^{c}	0	0	0
Yellow page telephone directory	14.67^{d}	3.70^{c}	2.00^{b}	0.29^{b}	33.33^{b}	88.89^{a}	22.22^{ab}	0	0	0
Local newspaper	16.33^{c}	3.94^{c}	3.33^{a}	0.53^{a}	23.78^{c}	33.33^{c}	25.81^{a}	0	0	0
Control (Unbagged)	7.00^{e}	1.90^{d}	1.00^{c}	0.39^{ab}	66.67^{a}	0^{d}	16.67^{b}	0	0	0

[1]Data transformed to square root of (x + 0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT
*Insect damage due to cecid fly/helopeltis bug, mealy bug, scale insect and fruit fly.

Table 8b. Continuation . . . .

Treatment	Total fruits harvested (pcs)	Weight (kg)	Non-marketable[1] (pcs)	Non-marketable[1] (kg)	Causes of non-marketable (%)[1] Insects*	Bioko	Fruit Cracking	Wind scars	Latex stains	Ripening
CY 2000										
Thick waxy magazine	51.50^{a}	14.14^{a}	5.25^{bc}	1.29^{b}	78.93^{b}	51.31^{b}	33.22^{cd}	0	74.14^{b}	7.14^{b}
Thin waxy magazine	48.75^{a}	12.70^{a}	8.25^{a}	1.79^{a}	45.34^{d}	54.86^{b}	31.60^{d}	0	56.75^{d}	13.89^{a}
Imported newspaper	48.50^{a}	13.22^{a}	4.50^{c}	1.11^{b}	91.67^{a}	40.00^{c}	52.08^{b}	0	70.42^{c}	15.0^{a}
Local newspaper	50.00^{a}	13.26^{a}	7.00^{ab}	1.58^{a}	52.08^{c}	71.87^{a}	35.42^{c}	0	55.21^{d}	6.25^{b}
Control *(Unbagged)*	11.50^{b}	3.53^{b}	1.50^{d}	0.60^{c}	91.67^{a}	8.33^{d}	58.33^{a}	0	100^{a}	0^{c}
CY 2001										
Thick waxy magazine	60.25	14.99^{ns}	7.75^{a}	1.34^{b}	88.31^{a}	73.0^{a}	19.94^{b}	48.33^{b}	0	16.52^{d}
Thin waxy magazine	59.50	15.61	8.50^{a}	1.76^{a}	72.84^{b}	47.0^{b}	28.32^{a}	22.55^{d}	0	35.24^{b}
Imported newspaper	62.00	16.80	7.75^{a}	1.81^{a}	68.54^{c}	19.25^{c}	18.91^{bc}	39.75^{c}	0	42.44^{a}
Local newspaper	52.50	13.87	4.25^{b}	0.90^{c}	89.29^{a}	48.22^{b}	16.97^{c}	56.25^{a}	0	22.32^{c}
Local newspaper w/ Lorsban impregnated plastic strips	57.25	14.76	8.50^{a}	1.67^{a}	41.92^{d}	70.0^{a}	27.27^{a}	37.75^{c}	0	24.89^{c}

[1]Data transformed to square root of (x + 0.5)
In column, means having similar letter superscripts are not significantly different at 5% level using DMRT
*Insect damage due to cecid fly/helopeltis bug, mealy bug, scale insect and fruit fly.

Fruit cracking was significant on unbagged fruits (58.33%), followed by imported newspaper (52.08%) while the lowest from thin waxy magazine (31.60%). Latex damage of 100% was obtained from unbagged fruits and was significantly different compared with bagged fruits. Latex damage among bagging materials ranged from 55.21 to 74.14% with highest on thick waxy magazine and lowest on local newspaper. Early ripening was observed on thin waxy magazine (13.89%) imported newspaper (15%). Local newspaper showed the lowest ripening 6.25% at harvest.

The incidence of insect and bioko on non-marketable fruits was high among bagging materials for CY 2001. The highest insect damage was recorded on local newspaper (89.29%) and thick waxy magazine (88.31%) while incidence of bioko on thin waxy magazine was 73% followed by local newspaper with LIPS of 70%. Fruit cracking was significant on thin waxy magazine (28.32%) and local newspaper with LIPS (27.27%). Wind scar was significant on local newspaper while ripening on imported newspaper with 56.25 and 42.44%, respectively.

Generally, the causes of non-marketable fruits among treatments were due to insect damage, bioko/deformed fruit, fruit cracking, wind scar and latex stain in decreasing order.

Economic Analysis. Table 9, presents the cost and return analysis of the different bagging materials in all trials based on marketable fruits. Results showed that the highest material and labor cost per one hundred fruits was recorded on brown paper bag, followed by thick waxy magazine and imported newspaper while the lowest on yellow page telephone directory with P32.25, P23.12, P 22.84 and P20.02, respectively. Mean marketable yield obtained from different bagging materials in all seasons ranged from 6.82 to 17.74 kgs. Unbagged fruits showed the lowest with 6.17 kgs. Farm gate price however, varied with season. The mean income was highest on thick waxy magazine (P274.90) followed by brown paper bag (P266.10), imported newspaper (P263.09) and local newspaper with LIPS (P 261.86).

Table 9. Cost and return analysis (1998-2001)1.

TREATMENT	Cost of bagging /100 pieces fruits (₱)			Marketable yield/treatment (kg)				Mean marketable yield (kg)	Price (₱)	Net Income (₱)	%Increase[2] in income over the control	Cost of bagging/kg marketable yield (₱)
	Materials	Labor	Total	1998	1999	2000	2001					
Brown paper bag	22.25	10.00	32.25	17.74	-	-	-	17.74	266.10	233.85	53.19	1.82
Thick waxy magazine	13.12	10.00	23.12	-	10.76	12.85	13.65	12.42	274.90	251.78	56.53	1.86
Thin waxy magazine	12.41	10.00	22.41	17.07	9.62	10.91	13.85	13.01	255.64	233.23	53.07	1.72
Yellow page telephone directory	10.02	10.00	20.02	-	6.82	-	-	6.82	170.50	150.48	27.27	2.94
Imported newspaper	12.84	10.00	22.84	14.27	-	12.51	15.0	13.92	263.09	240.25	54.44	1.64
Local newspaper	10.98	10.00	20.98	16.38	6.82	11.68	12.97	11.96	233.14	212.16	48.41	1.75
Local newspaper with Lorsban impregnated plastic strips (LIPS)	12.61	10.00	22.61	-	-	-	13.09	13.09	261.86	239.25	54.25	1.73
Control	-	-	-	12.56	3.02	2.93	-	6.17	109.45	-	-	-

[1]Computed based on marketable yield retained from 100 tagged panicles.

2% Increase in income over the unbagged = $\frac{\text{Net income - Income of unbagged}}{\text{Net Income}} \times 100$

Straight buying - Price/kg.
1998 - P15.00
1999 - P 25.00
2000 - P 22.00
2001 - P 20.00

Yellow page telephone directory gave the lowest income of P170.50. Highest monetary net return was recorded on thick waxy magazine, followed by imported newspaper, local newspaper with lorsban impregnated plastic strips, brown paper bag and thin waxy magazine with P251.78, P240.25, P239.25, P233.85 and P233.23, respectively. Yellow page telephone directory gave the lowest return of P170.50 and unbagged with P109.45. Percent increase in income through bagging compared with unbagged was also determined. Thick waxy magazine gave the highest increase of 56.53% over the control. This was followed by imported newspaper, local newspaper with lorsban impregnated plastic strips (LIPS), and brown paper bag with 54.44, 54.25 and 53.19 percent, respectively. Yellow page telephone directory gave the lowest increase in income 27.27% and recorded the highest cost of labor and materials per kilogram fruits (P 2.94). Imported newspaper (P1.64) showed the lowest bagging cost per kilogram fruit followed by thin waxy magazine (P1.72). Although thick waxy magazine has shown higher cost per kilogram fruit, this was compensated by higher production of marketable fruits. Imported newspaper, thick and thin waxy magazine were found best and economical bagging materials for mango fruits in all seasons. Local newspaper with LIPS also gave the lowest cost per kilogram fruit and higher benefit, result obtained was only from one trial and should be verified. On the other hand, brown paper bag and local newspaper were profitable only during dry season since these materials could not withstand heavy rainfall. Yellow page telephone directory and the control showed the lowest both in marketable yield and monetary return.

CONCLUSIONS AND RECOMMENDATIONS

Fruit bagging using different papers can reduce insect and disease damage, minimize quality defects of mango fruits. However, bagging does not provide complete protection of fruits.

Bagged and unbagged fruits showed no significant differences on the external (except in peel color at harvest) and internal qualities. Peel color of bagged fruits at harvest was pale green while unbagged fruits green. On the other hand, daily change in peel color of bagged and unbagged fruits stored at ambient temperature monitored 1 to 8 days after harvest did not differ among the treatments.

Defects on mango fruits (bioko, wind scar, fruit cracking and latex stain) have no consistent trend except in early ripening of fruits bagged with thin waxy magazine which was significant in most trials compared to the rest of the treatments.

The significant effects of bagging using different paper materials was achieved with high recovery of marketable fruits over the unbagged ones.

Imported newspaper, thick and thin waxy magazines recorded the most promising and economical bagging materials for mango fruits. However, source and availability of these materials should be considered. Brown paper bag and local newspaper were profitable only during dry season since these materials are easily destroyed during rainy days. Imported newspaper, thick and thin waxy magazine are recommended during off-season production, when rain is abundant.

IMPLICATIONS OF THE STUDY

1. Bagging should be incorporated in the cultural management for bearing trees since it can reduce pest incidence and lower the cost of crop protection.
2. The right bagging material(s) should be used. Brown paper bag and local newspaper during dry season while imported newspaper, thin and thick waxy magazines during rainy season.
3. Bagging does not provide total protection of mango fruits from pests. Hence, other cultural management such as pruning, early protection of fruits through chemical spray and proper fertilization should be done.
4. Training in bagging of fruits can create new jobs which can augment the income of growers.

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Appendix 1. Average temperature, relative humidity, total rainfall and number of rainy days (CY 1998-2001).

YEAR	Average Temp. (°C)	Relative Humidity (%)	Rainfall (mm)	No. of Rainy Days
1998	28.67(29.06)	81.10-85.60	79.75 (61.75)	10 (8)
1999	27.61(27.62)	81.50-88.72	998.44 (812.44)	84 (69)
2000	27.38(27.71)	76.68-87.94	1.004.70 (931.20)	77 (57)
2001	26.92(27.69)	80.55-86.67	645.90 (535.80)	47 (38)

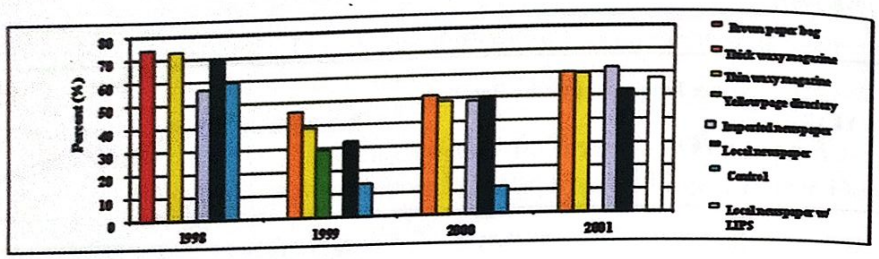
Figure in parenthesis represents the actual data recorded during the duration of the study.

Appendix 2. Breakdown costs of materials and labor.

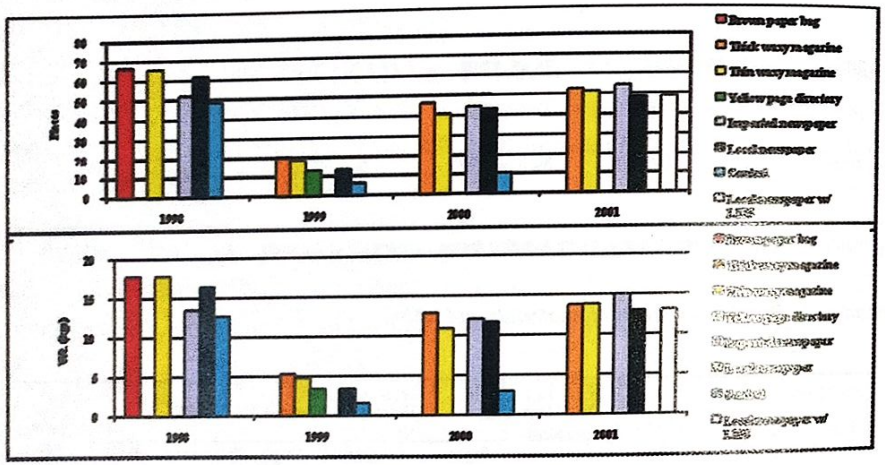
Treatment	Cost/kg (₱)	No. of bags produced (pcs)	Material and labor costs/100 fruits (₱)					Total (₱)
			Paper bags	Freight & Handling	Staple wire	Preparation of bags	Fruit bagging	
Brown paper bag	21.00	100	21.00	0.25	1.00	-	10.00	32.25
Thick waxy magazine	10.00	200	4.54	0.37	2.50	5.00	10.00	23.12
Thin waxy magazine	15.00	330	5.00	0.62	2.50	5.00	10.00	22.41
Yellow page tel. Dir.	10.00	430	3.06	0.39	2.50	5.00	10.00	20.02
Imported newspaper	15.75	318	2.32	0.20	2.50	5.00	10.00	22.84
Local newspaper	9.00	294	4.95	0.39	2.50	5.00	10.00	20.98
Local newspaper w/ Lorsban impregnated plastic strips (LIPS) 1 kg LIPS = 64" x 1,560" Cut = 1.5 x 511 = 7.5 sq."	9.00 LIPS=150/kg	294 13.312	3.06 1.12	0.425 0.010	2.50	5.00 0.50*	10.00	22.61

*Labor cutting lorsban impregnated plastic strips.

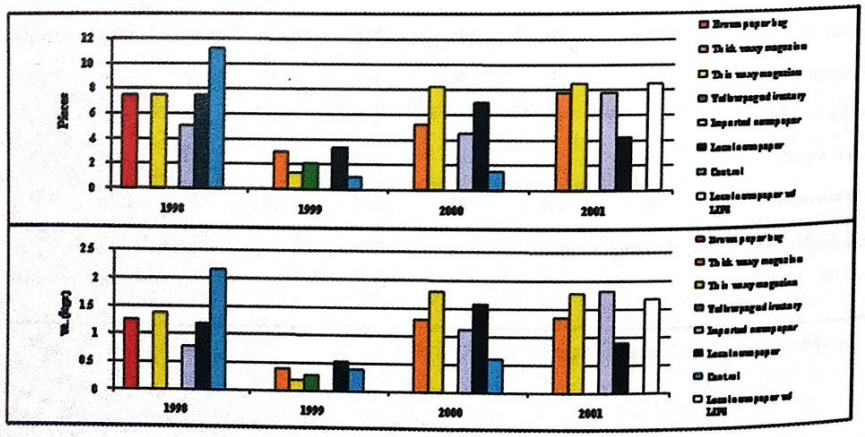
Appendix 3. Number of fruits retained and its classification subjected to different treatments.



Number of fruits retained (%) at harvest subjected to the different treatments.

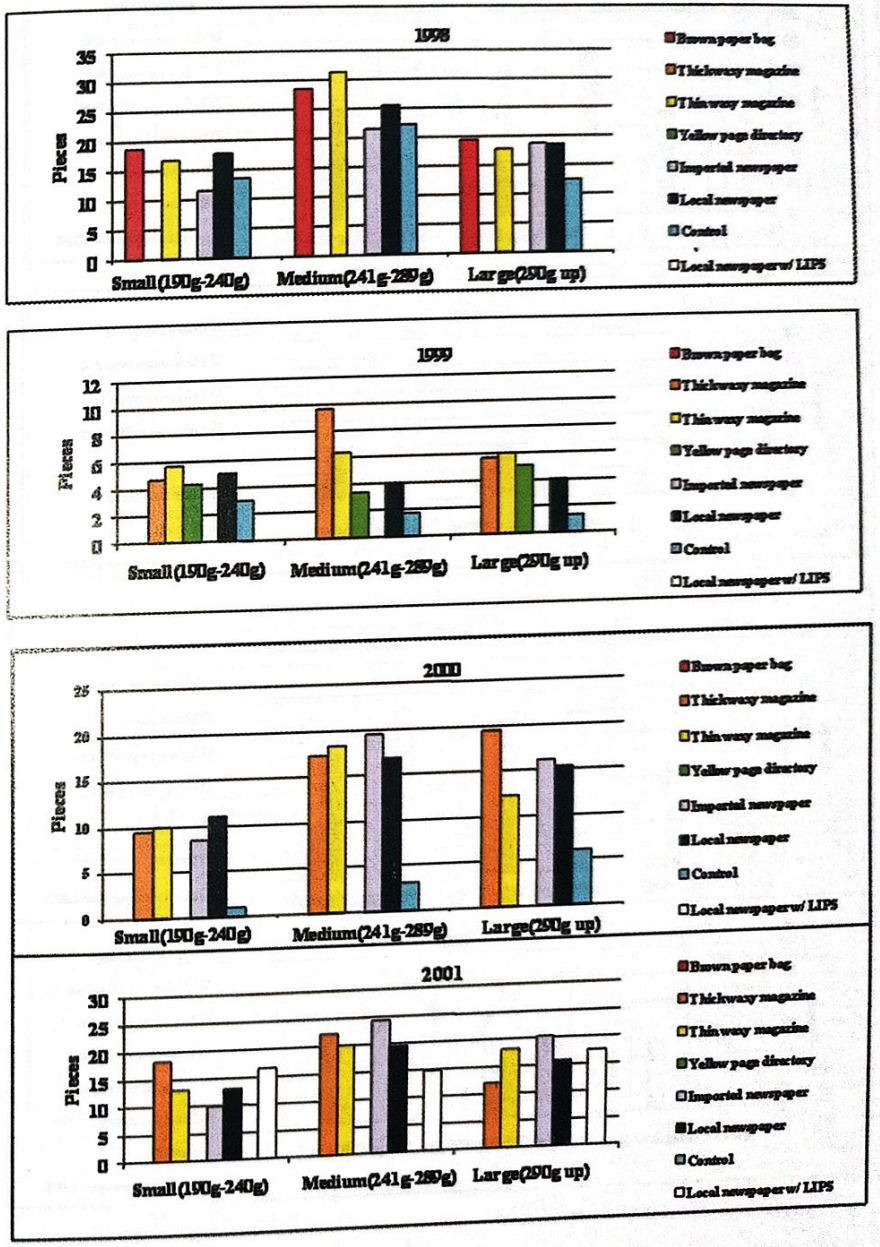


Marketable fruits retained (%) at harvest subjected to the different treatments.

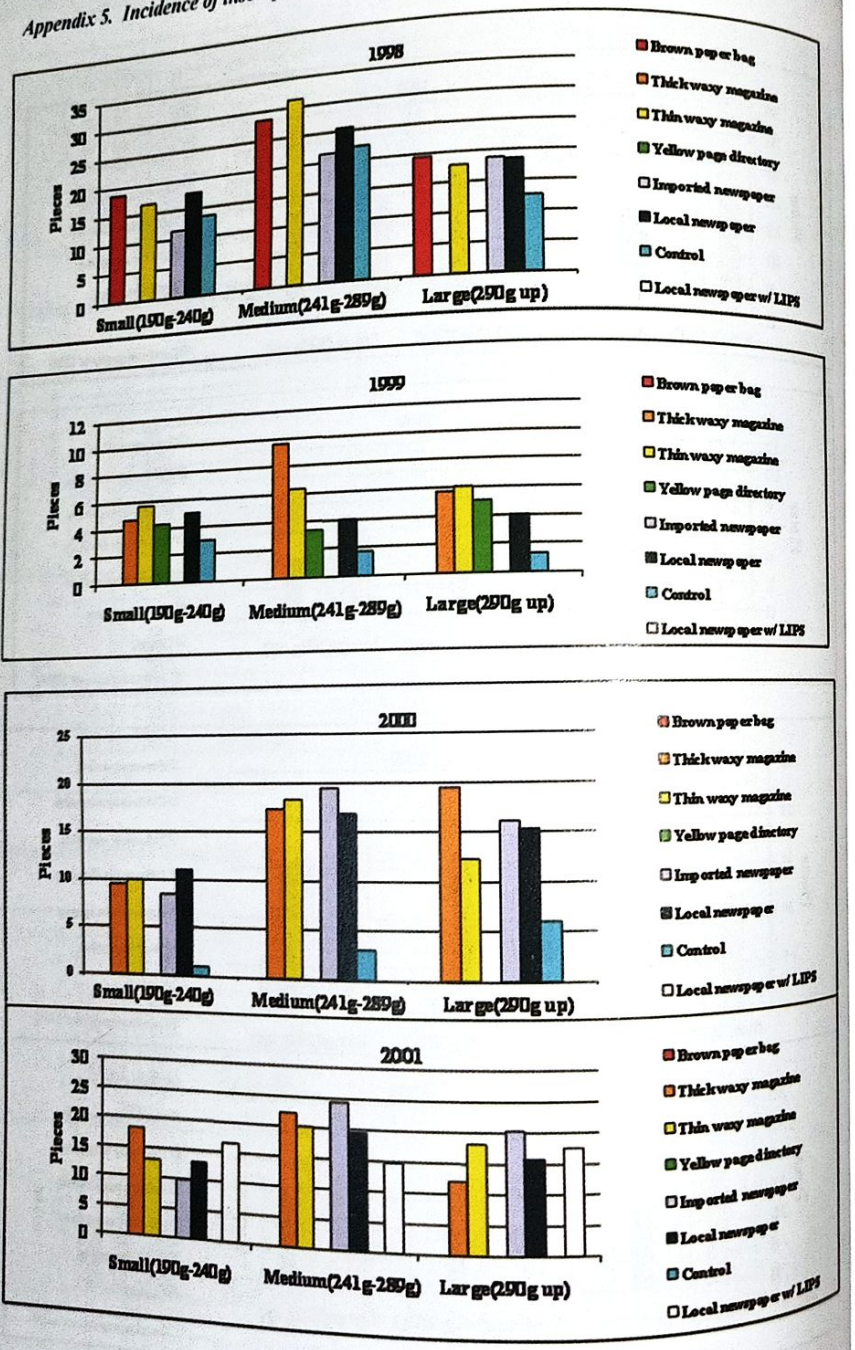


Non marketable fruits retained at harvest subjected to different treatments

Appendix 4. Size classification of marketable fruits (pcs).



Appendix 5. Incidence of insect pest on mango fruits retained at harvest.



Appendix 6 Defects of mango fruitts retained at harvest