

Test 1 Tolerance of 'Fuji' Apples to Methyl Bromide Fumigation

Materials and Methods

1. Test Fruit

'Bagged Fuji' Apples

Apples, which were stored at ambient temperature (at 10 to 15°C) for 7 days and then at 1.5°C for 27 days and at -1 to 0°C for 68 to 98 days under Standard Cold storage (SC) after harvest, were obtained from a packing house in Hirosaki City, Aomori Prefecture. These fruit were stored at 15°C for 1 to 3 days before fumigation.

'Unbagged Fuji' Apples

Apples, which were stored at ambient temperature (at 10 to 15°C) for 14 days and then at 1.5°C for 39 days and for 3 to 5°C for 65 to 104 days under SC storage, were obtained from a packing house in Morioka City, Iwate Prefecture. These fruit were stored at 15°C for 1 to 3 days before fumigation.

2. Fumigation

A 29.5 ℓ fiber-glass fumigation chamber (26.0 cm × 28.0 cm × 41.0 cm in size) equipped with circulation fan, ventilation apparatus, and ports for gas application and sampling, and manometer and temperature probes was used in the fumigation room maintained at 15°C. Apples, which were placed in the fumigation boxes, were fumigated at doses of 30, 40 or 50 g/m³ of methyl bromide for 2 hours at 15°C with 0.1 kg/ℓ loading.

The built-in circulation apparatus was used throughout the fumigation. Gas concentrations were monitored with a gas chromatograph (FID: GC 8AF, Shimazu) at 30, 60 and 120 minutes after injection of methyl bromide. Following fumigation, all boxes were exhausted for one hour at 15°C by using the ventilation apparatus.

3. Storage of Fumigated Fruit

Fumigated fruit were placed in a polyethylene bag (0.05 mm in thickness) with five fruit per bag and stored at 1.5°C for 4 weeks. Use of polyethylene bags was considered to create favorable conditions for chemical injury on apples.

4. Evaluation of Injury

Apples stored for the prescribed period were taken out and evaluated mainly for skin and pulp color of apples.

Results and Discussion

1. Methyl Bromide Concentrations During Fumigation

Methyl bromide concentrations during fumigation are shown in Table 4-1. The average of residual gas concentrations were 29.2 mg/ℓ, 38.7 mg/ℓ and 48.5 mg/ℓ, respec-

Table 4-1. Methyl bromide concentrations recorded in a 29.6 ℓ fumigation chamber. Fumigation at doses of 30 g/m³, 40 g/m³ and 50 g/m³ for 2 hours at 15°C (Test 1).

Variety	Cold storage		Dose (g/m ³)	Gas concentration (mg/ ℓ)		
	Temperature (°C)	Period (Day)		30	120 min.	
Bagged Fuji	10-15	7	30	32.4	30.0	
			40	42.9	39.3	
			50	52.3	48.0	
	1.5	27	30	32.3	29.8	
			40	43.0	39.5	
			50	53.6	49.3	
	-1-0	68	30	32.5	29.6	
			40	43.1	39.3	
			50	52.7	48.0	
	-1-0	98	30	31.8	28.9	
			40	42.0	38.7	
			50	53.2	49.1	
	Unbagged Fuji	10-15	14	30	32.7	29.1
				40	43.3	39.0
				50	53.3	47.7
1.5		39	30	31.3	28.3	
			40	42.8	37.4	
			50	54.7	48.9	
3-5		65	30	32.3	29.0	
			40	43.3	39.1	
			50	53.1	48.0	
3-5		105	30	32.0	28.5	
			40	42.0	37.3	
			50	54.2	48.7	

tively, for initial doses of 30 g/m³, 40 g/m³ and 50 g/m³.

2. Fruit Injury

Table 4-2 shows results of the test on phytotoxicity of fumigated 'Bagged and Unbagged Fuji' apples.

'Bagged Fuji' Apples

Injury observed was between light and heavy, whether stored at ambient temperature (10 to 15°C) for 7 days or at 1.5°C for 27 days after harvest and fumigated at low doses. Spots were observed on the skin and the pulp had developed brown spots or discoloration. The spots on the skin were particularly noticeable with 'Bagged Fuji' than with 'Unbagged Fuji'. However, no injury was observed on the skin and the pulp of fruit stored at -1 to 0°C for 68 days or 98 days prior to fumigation and only slight injury was observed on apples stored for a month at 1.5°C.

Table 4-2. Phytotoxic response of 'Bagged Fuji' and 'Unbagged Fuji' apples fumigated with methyl bromide at doses of 30 g/m³, 40 g/m³ or 50 g/m³ for 2 hours at 15°C and stored for 4 weeks at 1.5±0.5°C (Test 1).

Variety	Storage temperature & period				*	Cont.	Methyl bromide dose (g/m ³)		
	Before fumigation		After fumigation				30	40	50
Bagged Fuji	10-15 °C	7 days	1.5 °C	4 weeks	skin	0/10	10/10	10/10	10/10
	1.5	27	1.5	4	skin	0/ 5	5/ 5	5/ 5	5/ 5
	-1-0	68	1.5	4	skin	0/10	0/10	0/10	0/10
	-1-0	98	1.5	4	skin	0/10	0/10	0/10	0/10
					pulp	0/10	0/10	0/10	0/10
Unbagged Fuji	10-15	14	1.5	4	skin	0/10	0/10	2/10	10/10
	1.5	39	1.5	4	skin	0/ 5	0/ 5	0/ 5	0/ 5
	3-5	65	1.5	4	skin	0/10	0/10	0/10	5/10
	3-5	105	1.5	4	skin	0/10	0/10	1/10	2/10
					pulp	0/10	0/10	1/10	2/10

No. of fruit injured/no. of fruit tested.

* Portion of injury observed.

'Unbagged Fuji' Apples

Injury was observed on the skin and the pulp of fruit stored at ambient temperature (10 to 15°C) for 14 days. Injury was also observed on both the skin and the pulp of fruit which had been stored at low temperatures (1.5°C or 3 to 5°C) for 39 to 105 days prior to fumigation. The injury, however, tended to decrease with an increase in storage time.

From the data, it was confirmed that 'Fuji' apples which had been stored for short periods after harvest were extremely susceptible to methyl bromide fumigation, and that apples which had been stored for one month or more before fumigation, were less susceptible to damage. This phenomenon was confirmed by SOMA et al. (unpublished data) in phytotoxicity tests for the 'Nijisseiki' cultivar of Japanese pears.

These data showed that 'Fuji' apples stored at such low temperatures as -1 to 0°C for 30 days or more after harvest could be tolerant to methyl bromide fumigation, and that chemical injury of 'Fuji' apples could be prevented even with fumigation with high doses of methyl bromide.