PRE-HARVEST FACTORS AFFECTING VASCULAR STREAKING AND QUALITY OF CASSAVA TUBERS

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ABSTRACT

Detopping of cassava plants at different degrees before harvest was undertaken to determine its effect on vascular streaking and quality during storage. Detopping the plants at 50-100% and stripping of all the leaves substantially delayed vascular streaking of the tubers during storage at ambient condition. However, it reduced the dry matter and starch contents of the tubers. A positive relationship was observed between severity of rotting and streaking but not between vascular streaking and percentage rotting.

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KEY WORDS: Cassava. Detopping. Vascular streaking. Starch. Dry matter. Rotting. Disease severity.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a major root crop grown in the Philippines which is largely used as a staple food especially by poor people in rural areas. It can substitute wheat flour in baked products by 10% (PCARR, 1977). To some extent, it is used for starch manufacture.

In spite of its various uses, the economic value of cassava cannot be fully exploited due to rapid deterioration of its tubers immediately after harvest (Ingram and Humphries, 1972; Robinson and Kutianawala, 1979). Cassava tubers can only be stored for 24 to 72 hours at ambient condition. Vascular streaking which is oftentimes followed by general rotting usually occurs after this period.

Vascular streaking is thought to be caused by enzymatic reaction. It is similar to the brownish discoloration

that normally appears during the fermentation of cassava which is due to the oxidation of leucoanthocyanin (Normancha and Pereira, 1943 as cited by Averre, 1967). The inner layer of the tuber is not discolored. However, vascular streaking is largely enhanced by mechanical damage during and after harvest (Akinreile, 1964; Booth, 1976) because of water loss through the wounds (Marriott et al., 1978).

While there are several methods to prevent deterioration of cassava tubers, only a few deal on the effect of pre-harvest factors. Castano et al. (1978), CIAT (1976) and Lozano et al. (1978) reported that physiological deterioration can be prevented by pruning the plants 3 weeks before harvest or by storing the harvested tubers in polyethylene bags. Microbial deterioration, on the other hand, can be prevented by immersing the tubers in a fungicidal solution such as Manzate.

This paper presents the effects of different degrees of detopping of cassava plants before harvest on vascular streaking and quality of the tubers during storage at ambient conditions.

MATERIALS AND METHODS

Detopping of Cassava Plants. Ten-month old native cassava (Binoboy cultivar) plants were detopped at 20 and 40 days before harvest using the following treatments:

1. 25% of the stem was detopped
2. 50% of the stem was detopped
3. 100% of the stem was detopped
4. OLR – Only the leaves were removed
5. Control – No detopping

These treatments were replicated three times in a randomized complete block design (RCBD). All the shoots which started to emerge at the nodes after cutting the stem were removed until the plants were harvested.

Harvesting, Transport and Sample Preparation. All the plants were harvested at the same time. They were carefully uprooted to avoid skinning and cracking of the tubers. The tubers were carefully cut from the stem and were left unwashed but the adhering soil particles were carefully removed. All the tubers were transported to the Postharvest Laboratory, Postharvest Horticulture Training and Research Center, U.P. at Los Banos.

Twenty uniform and undamaged tubers from each treatment were laid out in a table at ambient conditions (at temperature of 27.0°C $\pm$ 1.2°C and 85% $\pm$ 5% relative humidity). This was replicated three times.

Gathering of Data. Every sampling time, two sample tubers per replication in each treatment were observed for vascular streaking. The tubers were peeled and cut crosswise to assess vascular streaking using the rating scale below:

1– No vascular streaking
2– Less than 25% of the tuber area has vascular streaking
3– 26-50% of the tuber area has vascular streaking
4– 51-75% of the tuber area has

vascular streaking
5 – 76-100% of the tuber area has vascular streaking

Starch content (using the modified Nielsen method, 1943), weight loss, and dry matter content were monitored at harvest and at the termination of the study. Percent rotting and severity index were determined at the termination of the study. The former was computed using the formula:

$$\% \text{ Rotting} = \frac{\text{Number of rotten tubers}}{\text{Total number of sample tubers}} \times 100$$

while the latter was determined by classifying the rotten tubers according to the rating scale below:

1 – less than 20% of the tuber area is rotten
2 – 21-40% of the tuber area is rotten
3 – 41-60% of the tuber area is rotten
4 – 61-80% of the tuber area is rotten
5 – more than 80% of the tuber area is rotten

RESULTS AND DISCUSSION

Development of Vascular Streaking

Vascular streaking in cassava tubers was substantially reduced by detopping or stripping off all the leaves before harvest (Fig. 1). Severe vascular streaking was observed in the tubers from the undetopped plants after one day of storage compared to very slight streaking in the tubers from plants that were detopped or stripped of their leaves.

Vascular streaking developed slowly but progressively in tubers from the detopped plants regardless of the time of detopping. It started mostly at the proximal end of the tubers. The intensity of vascular streaking observed with time varied with the degree of detopping of the stem. The tubers from plants at 100% detopping had the slightest vascular streaking compared to. the rest of the detopped plants at 3, 5 and 7 days of storage at ambient condition. This result supported the observation of Lozano et al. (1978) that pruning the stem at 20 cm above the ground radically reduced the rate of postharvest deterioration of the tubers in the varieties studied. However if regrowth was allowed, the resistance to physiological deterioration decreased. Tubers from pruned plants developed lesser vascular streaking compared to the control tubers (Marriott et al., 1979).

The tubers from plants detopped at 40 days before harvest had generally less vascular streaking than the tubers from plants detopped at 20 days before harvest but the development with time was faster in the latter. Vascular streaking was more apparent during the first up to the third day of storage than during the latter period of storage. Beyond this period, no significant difference between the two detopping times was observed.

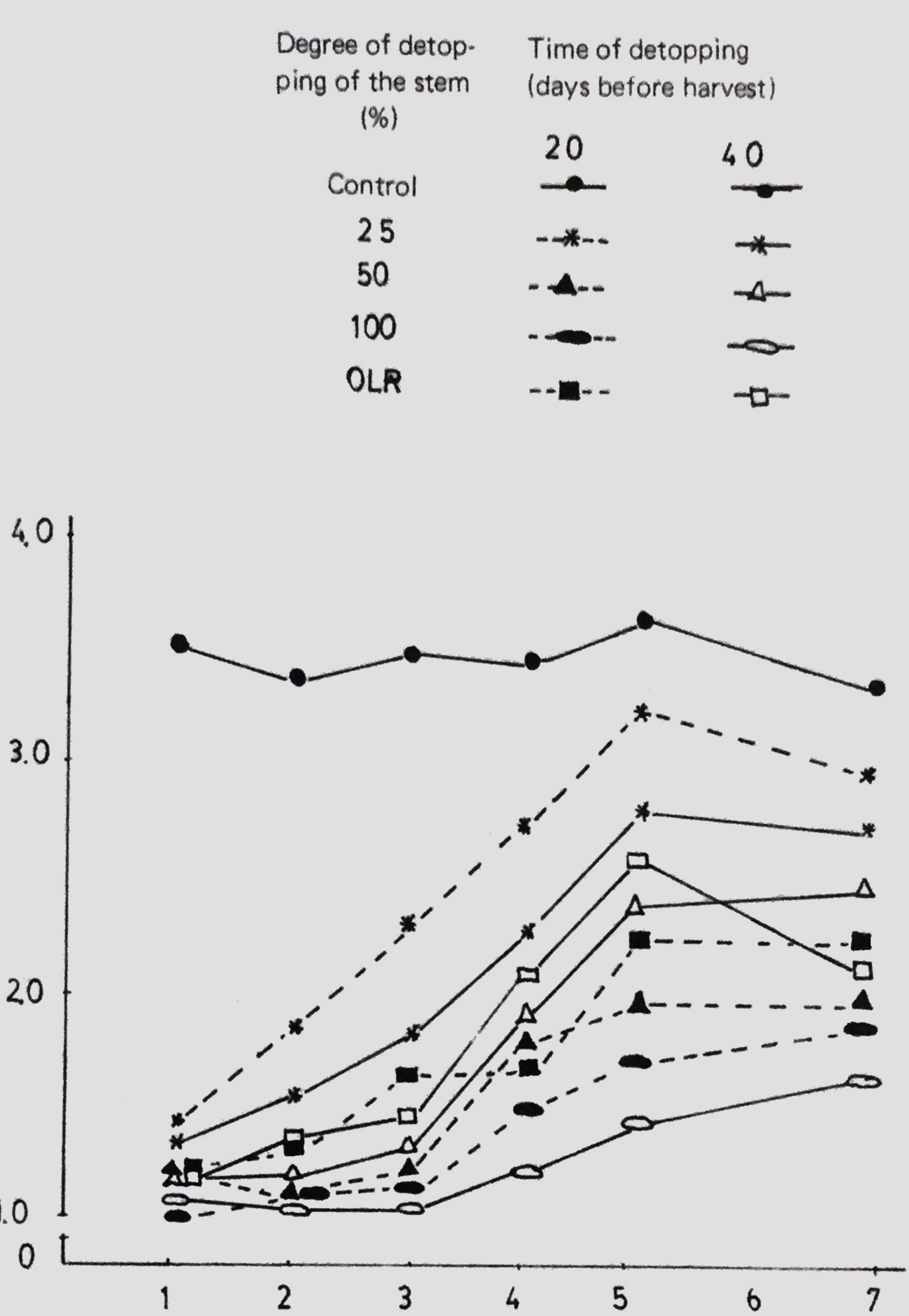

Fig. 1. Vascular streaking (while in storage) of cassava tubers harvested from plants subjected to various degrees and times of detopping.

Rotting of Tubers

Rotting of tubers stored at ambient conditions for 8 days occurred in all treatments at different magnitudes (Table 1). Tubers from plants detopped at 50 and 100% gave significantly lower percentage decay. Likewise, the disease severity was lowest in tubers from plants completely detopped (100%) in both times of detopping (Table 2). This seems to imply that complete detopping of the stem before harvest resulted in cellular alteration of the root tissues that impaired the growth of microorganisms. Correlation analysis between disease severity and degree of vascular streaking showed a significant positive relationship (Fig. 2). This result suggests that streaking enhanced microbial deterioration. Microorganisms are normally only involved late in secondary deterioration, utilizing the moribund tissues (Booth, 1977). On the other hand, percent rotting was not correlated with the degree of vascular streaking (Fig. 3) suggesting that rotting may occur even without vascular streaking.

The time of detopping the stem before harvest did not significantly affect severity index and percentage rotting (Table 3).

Table 1. Percentage rotting of cassava tubers stored for 8 days at ambient conditions as affected by degree and time of detopping before harvest.

Degree of Detopping	Percentage Rotting[1]	
	Time of Detopping (days before harvest)	
	20	40
0 (no detopping)	70.00a	70.00a
25% detopping	62.77b	62.00b
50% detopping	52.30c	56.33c
100% detopping	50.35c	51.14d
OLR (only leaves were removed)	61.18b	73.37a

[1] Means within a column followed by a common letter are not significantly different from each other at 5% level, DMRT.

Table 2. Severity index of cassava tubers stored for 8 days at ambient conditions as affected by degree and time of detopping before harvest.[1]

Degree of Detopping	Severity Index[2]	
	Time of Detopping (days before harvest)	
	20	40
0 (no detopping)	3.35 a	3.35 a
25% detopping	2.60 ab	3.40 a
50% detopping	3.28 a	2.46 b
100% detopping	1.71 c	1.51 c
OLR (only leaves were removed)	2.42 b	2.13 b

[1] Disease severity was determined based on the rotten area/tuber using the rating scale below:

1 – less than 20% of the tuber area is rotten
2 – 21-40% of the tuber area is rotten
3 – 41-60% of the tuber area is rotten
4 – 61-80% of the tuber area is rotten
5 – more than 80% of the tuber area is rotten

[2] Means within a column followed by a common letter are not significantly different from each other at 5% level, DMRT.

Table 3. Severity index and percentage rotting in cassava tubers after 8 days of storage as affected by time of detopping before harvest.

Time of Detopping	Severity Index[1]	Percent Rotting
20 days	2.67	59.33
40 days	2.57	62.57

[1] Values within a column were determined based on the rotten area/tuber using the rating scale below:

1 – less than 20% of the tuber area is rotten
2 – 21-40% of the tuber area is rotten
3 – 41-60% of the tuber area is rotten
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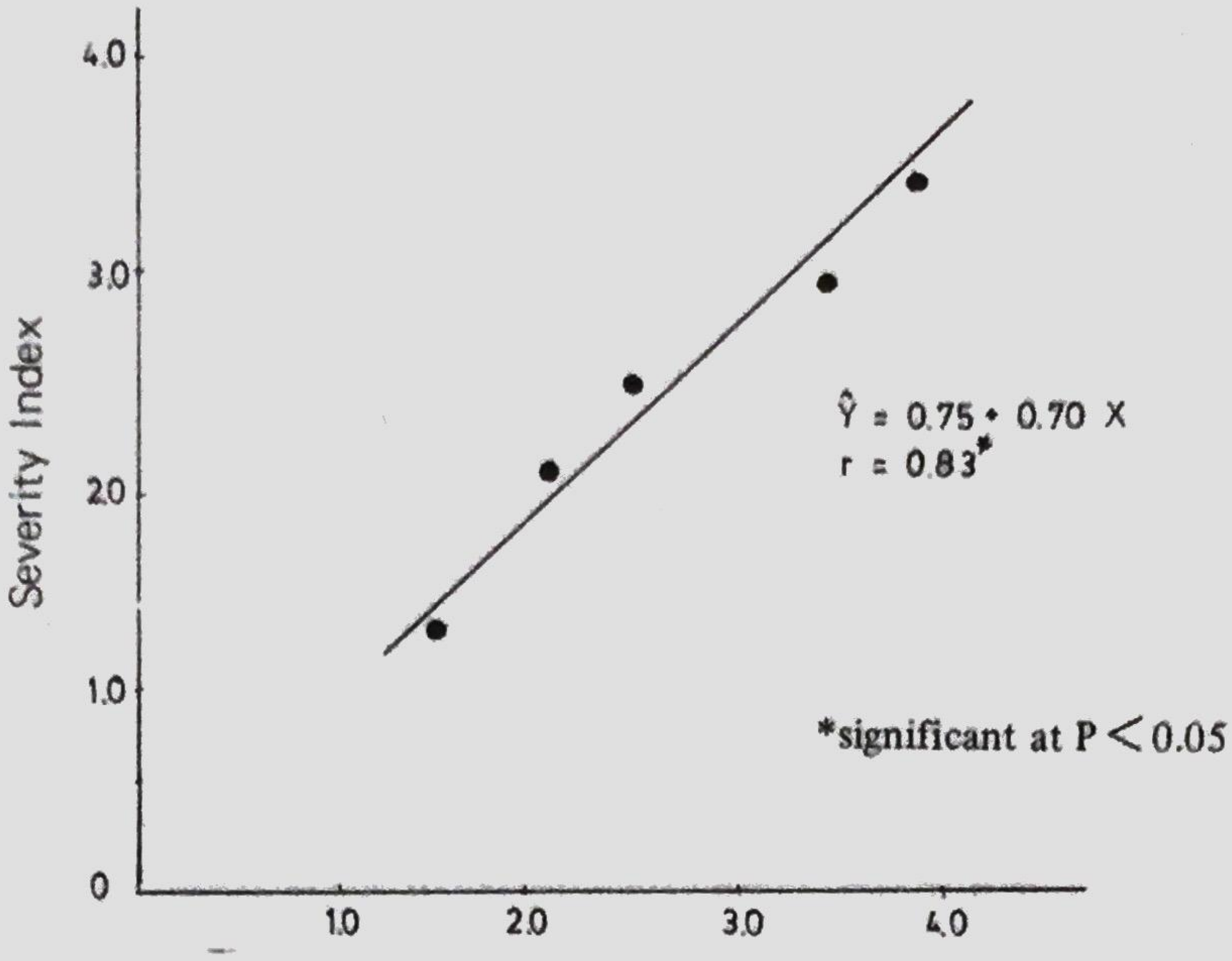

Fig. 2. Relationship between vascular streaking and severity of rotting in cassava tubers stored at ambient conditions.

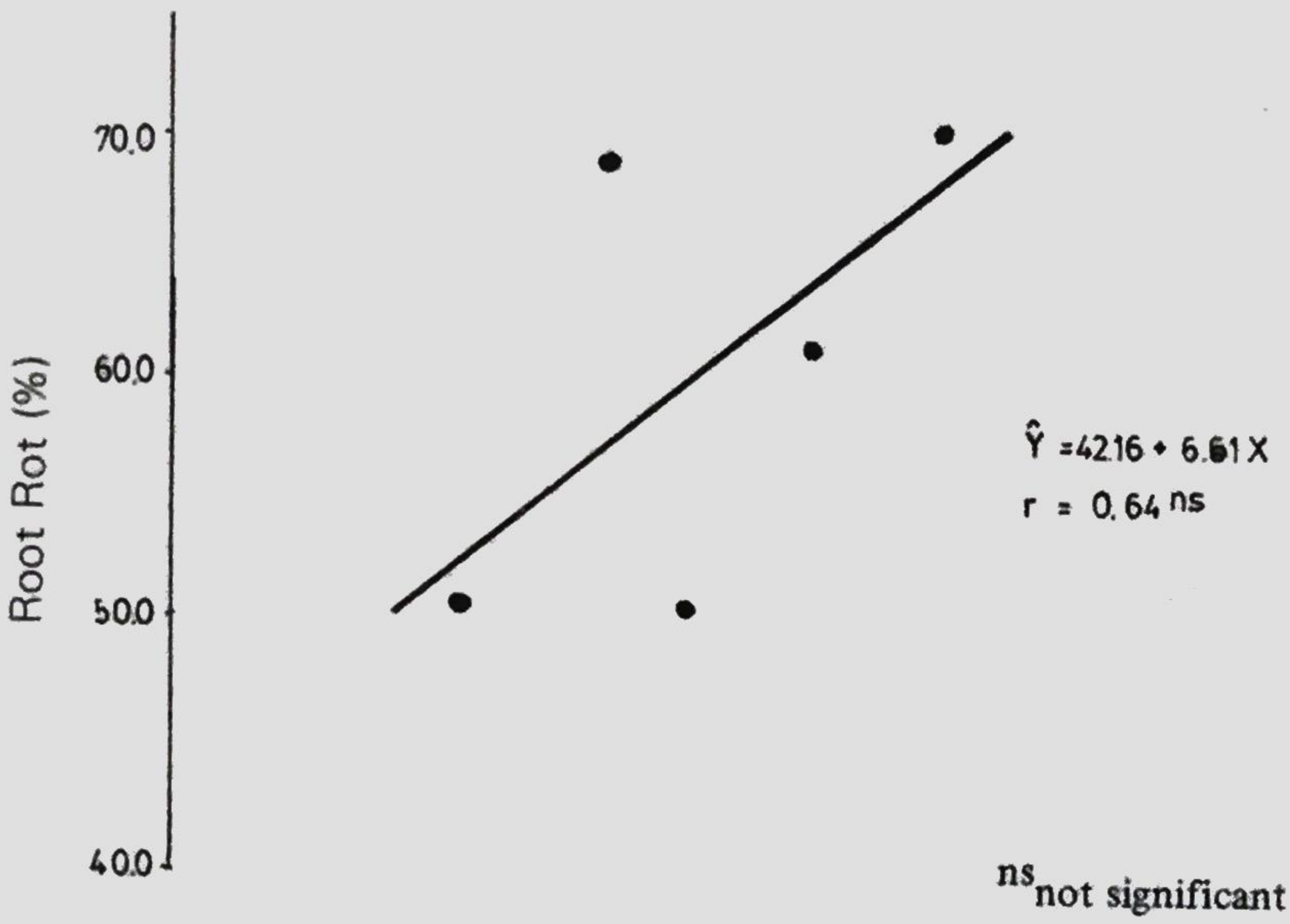

Fig. 3. Relationship between vascular streaking and percent rotting in cassava tubers stored at ambient conditions.

Changes in Weight, Dry Matter and Starch Content

The different degrees of detopping of the plants before harvest also affected cumulative weight loss (Fig. 4a). Tubers from plants detopped at 100% gave the lowest weight loss compared to the tubers from undetopped plants. No significant differences were observed between the two times of detopping of the stem. However, weight losses were relatively lower in tubers from detopped plants compared to the tubers from undetopped plants (Fig. 4b).

The dry matter content was significantly reduced in tubers from plants detopped at 50-100% and stripped of all the leaves than in those from undetopped plants and those detopped at 25% in both times of detopping (Fig. 5). This result is consonant with the finding of Dahniya et al. (1981) that frequent removal of leaves significantly reduced the dry matter content of the tubers. This is expected

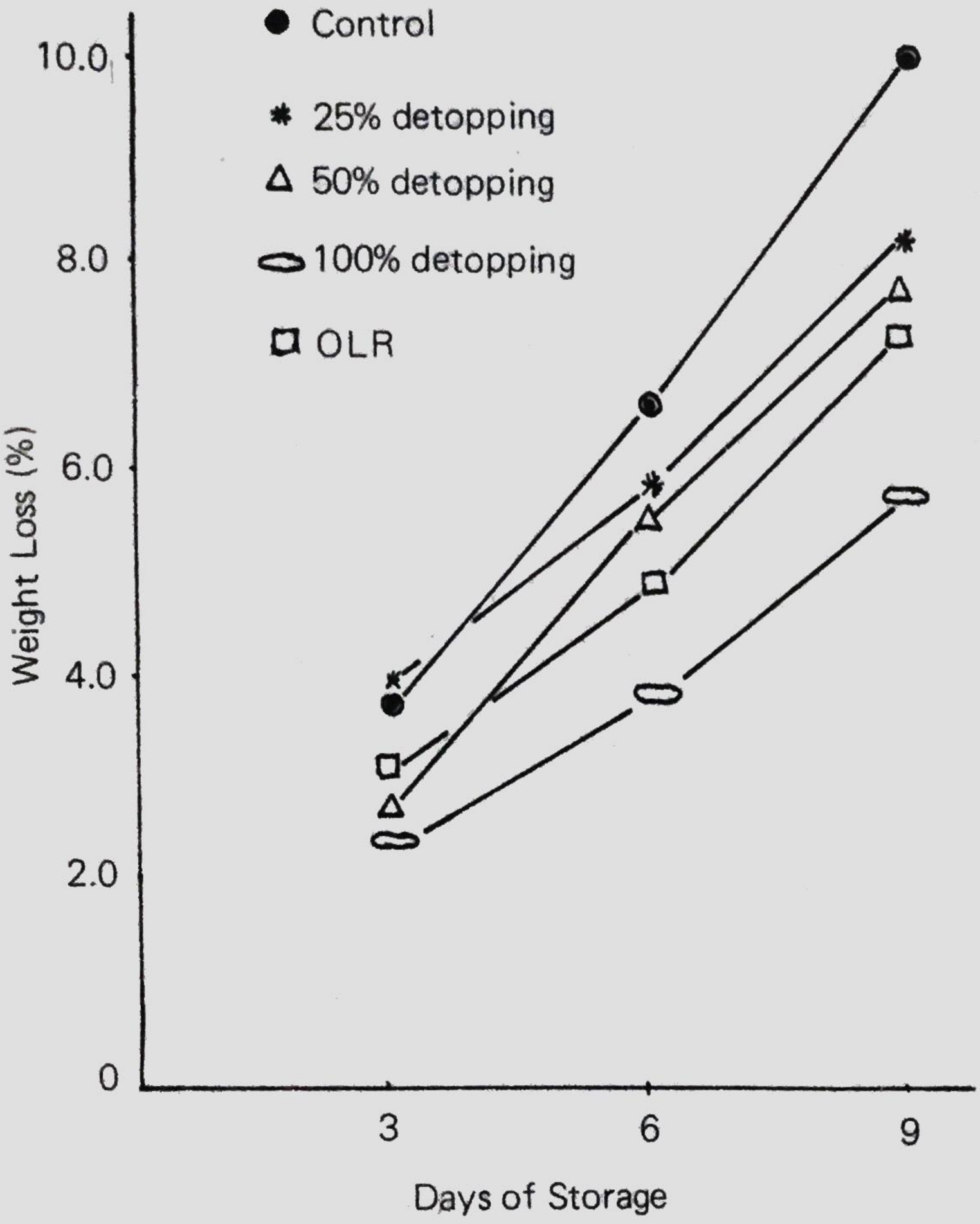

Fig. 4a. Cumulative weight loss during storage of cassava tubers harvested from plants subjected to different degrees of detopping.

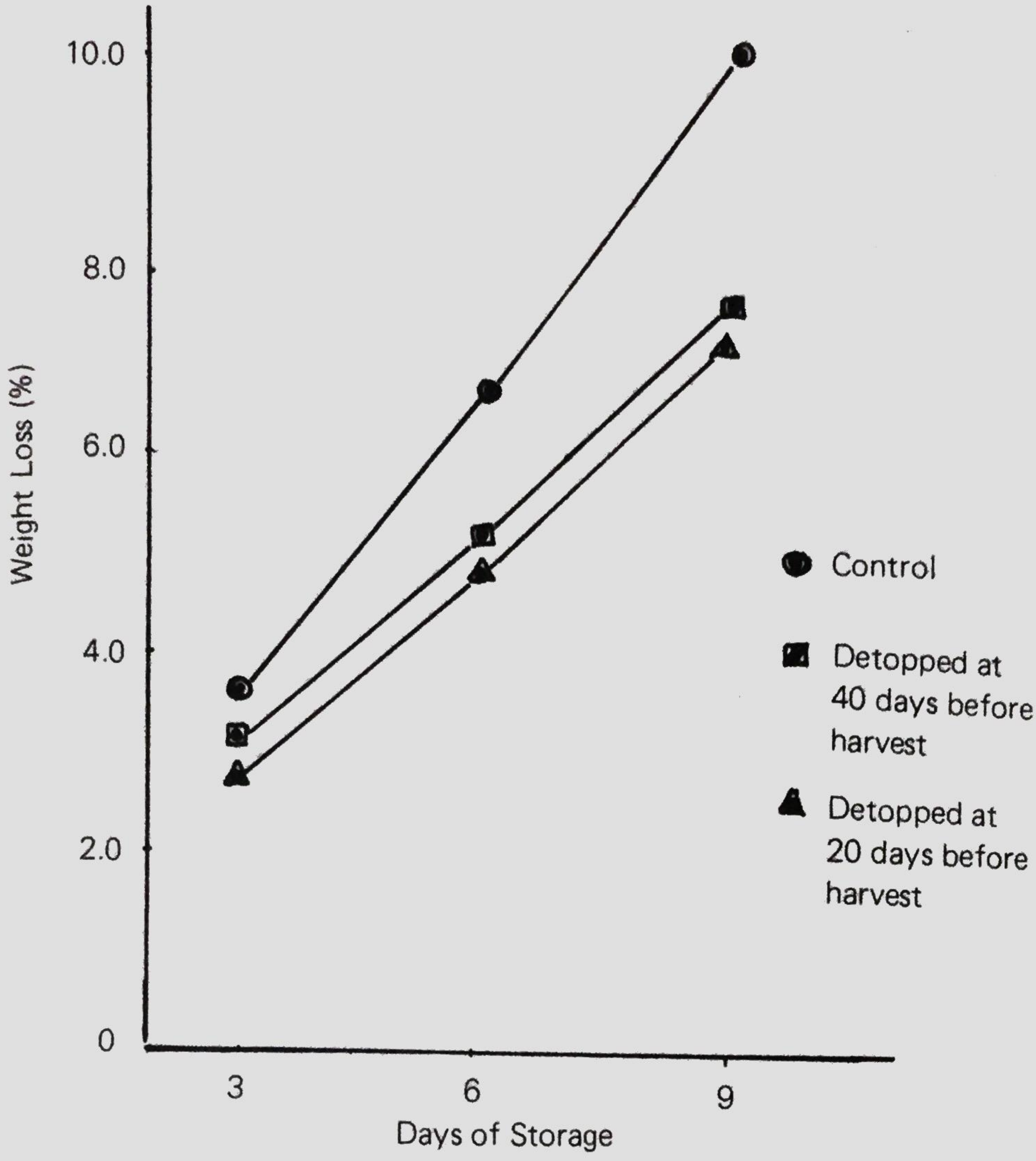

Fig. 4b. Cumulative weight loss during storage of cassava tubers harvested from plants detopped at 20 and 40 days before harvest.

because of reduction in photosynthetic area, thus the starch content was also affected. The tubers from undetopped plants and from those detopped at 25% exhibited a relatively higher starch content than the tubers from plants detopped at 50-100% and stripped of all the leaves (Fig. 6). The deposition of starch and the proliferation of parenchymatous cells in the tubers are reduced when the synthesis of carbohydrates in the leaves is stopped (Hunt et al., 1977).

On the other hand, the dry matter content in the tubers from plants detopped at 20 and 40 days before harvest regardless of the degree of detopping and from the control (undetopped plants) decreased slightly after 8 days of storage (Fig. 7). Likewise, the starch content generally decreased after 8 days of storage except in the tubers from plants detopped at 20 days before harvest (Fig. 8). This is expected because starch is converted to sugar during storage (Booth and Coursey, 1974).

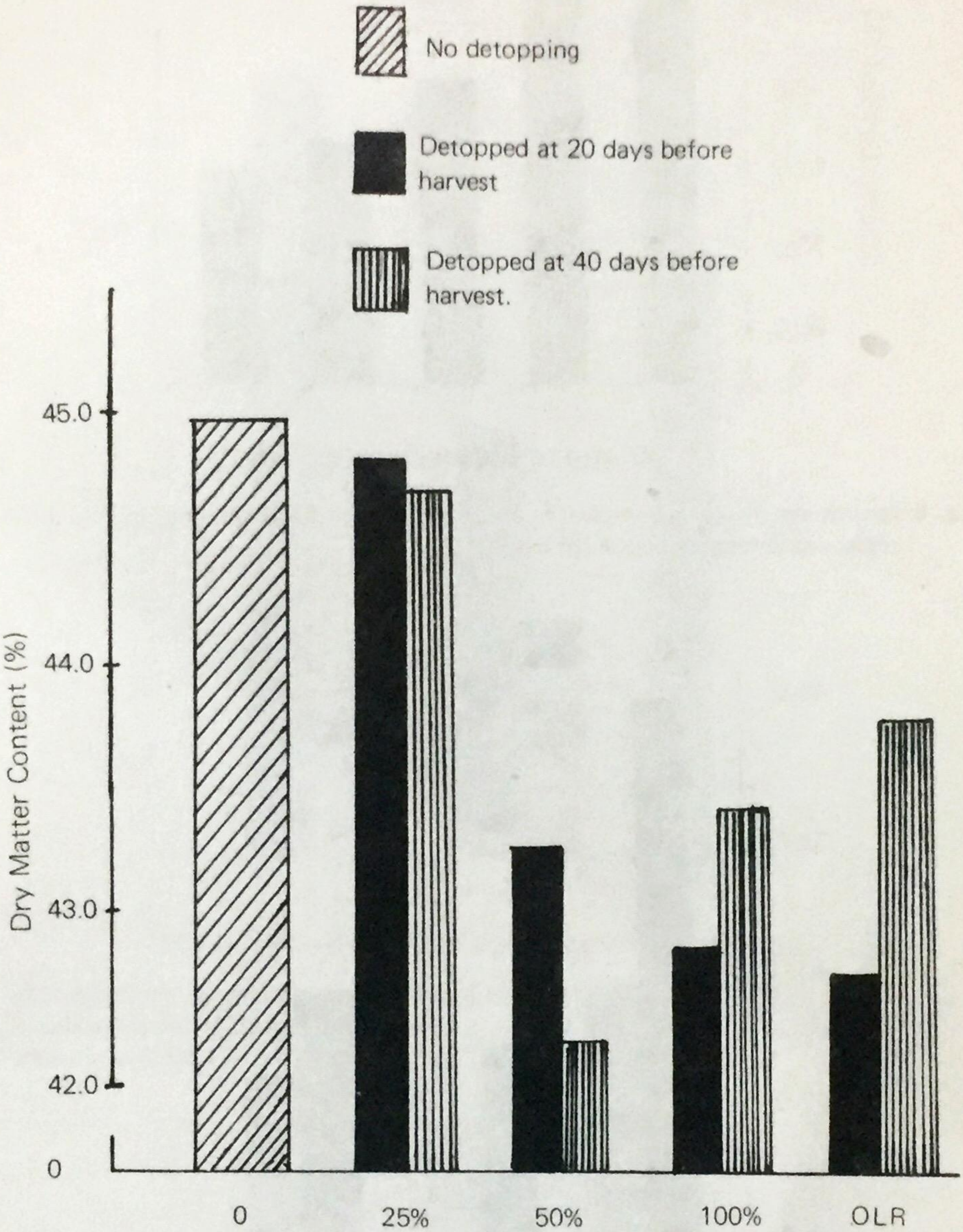

Fig. 5. Percent dry matter of cassava tubers harvested from plants subjected to different degrees and times of detopping.

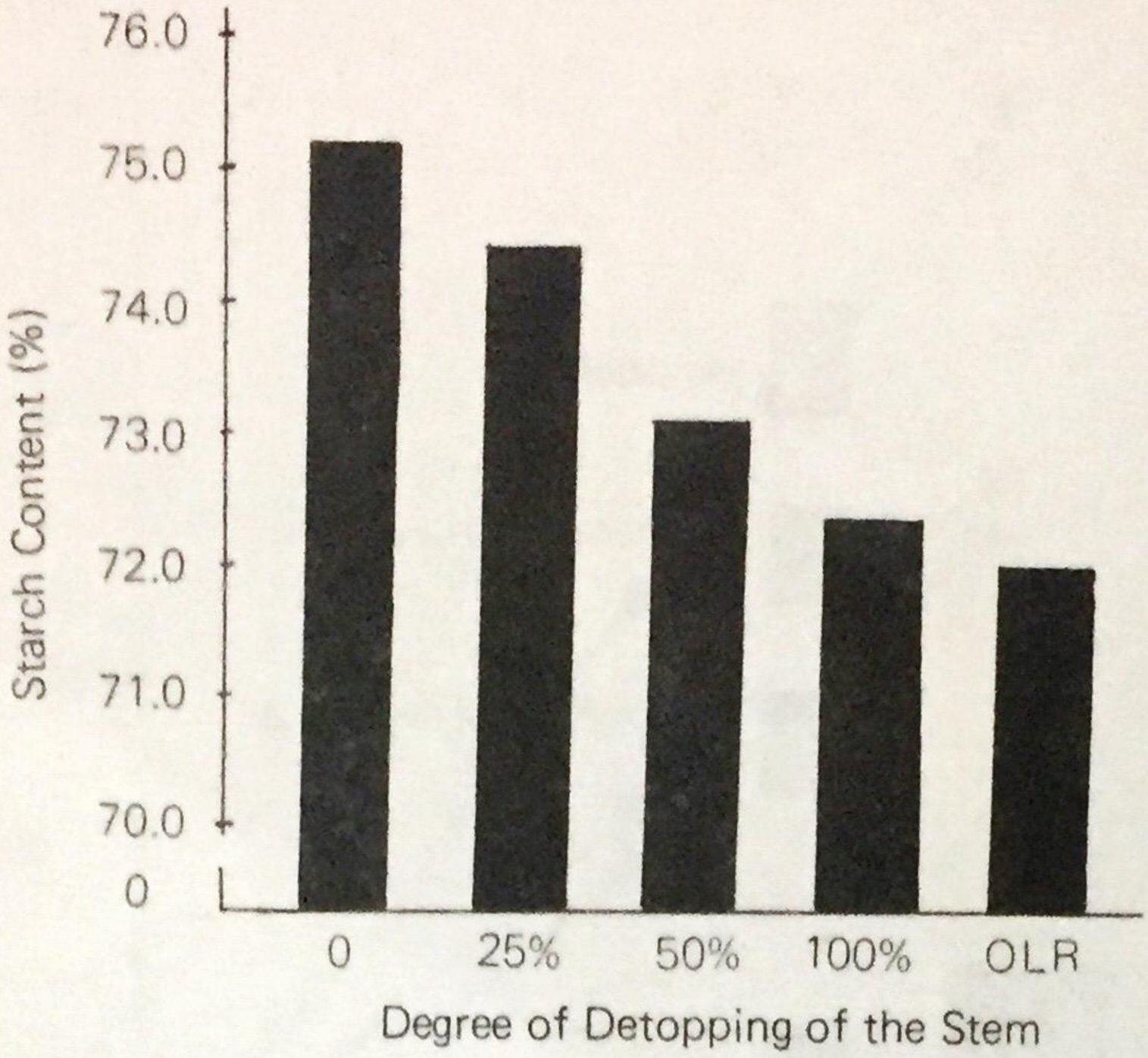

Fig. 6. Percent starch content of cassava tubers at harvest from plants subjected to different degrees of detopping before harvest.

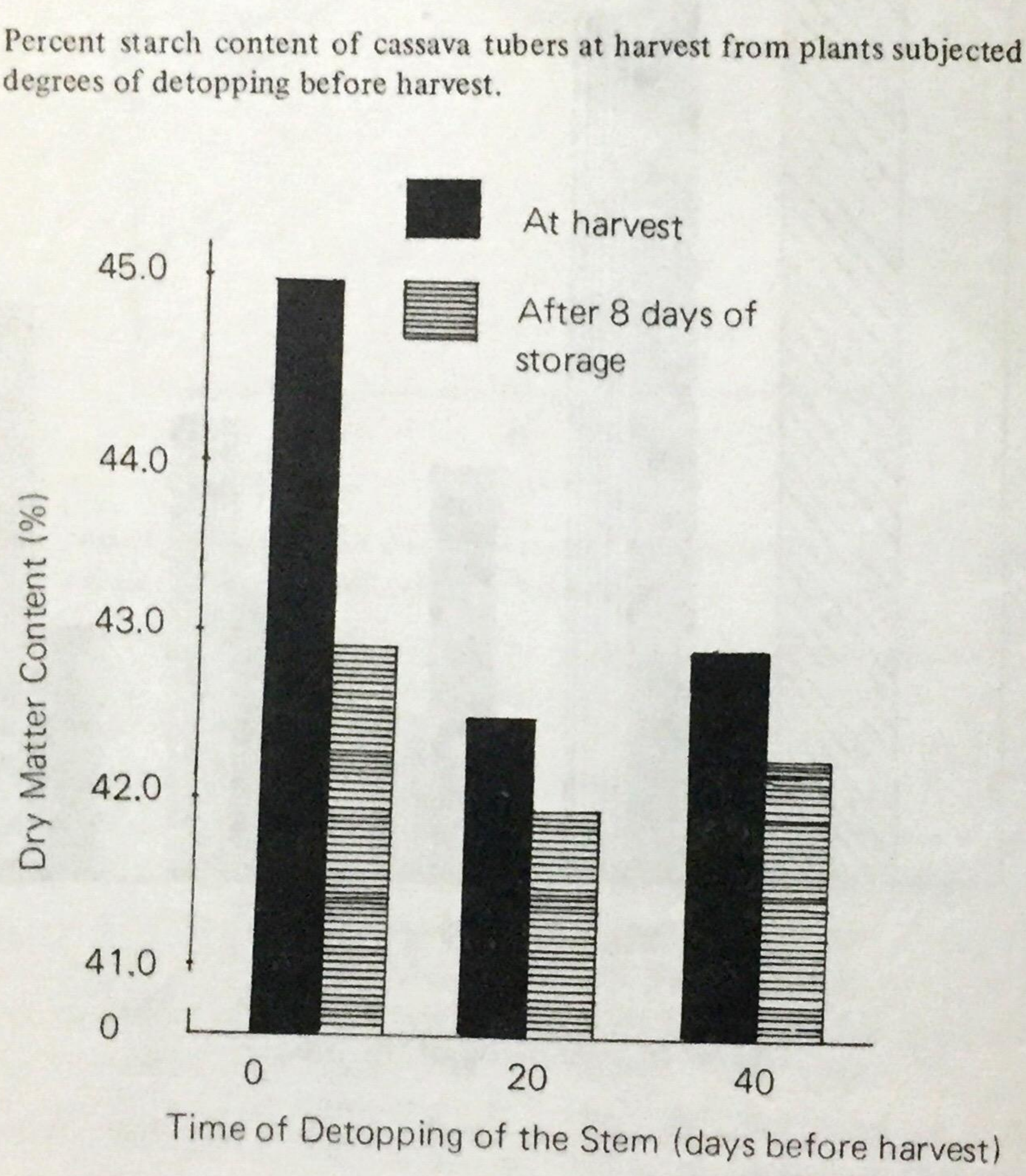

Fig. 7. Percent dry matter content of cassava tubers (at harvest and after 8 days of storage) from plants detopped at 20 and 40 days before harvest.

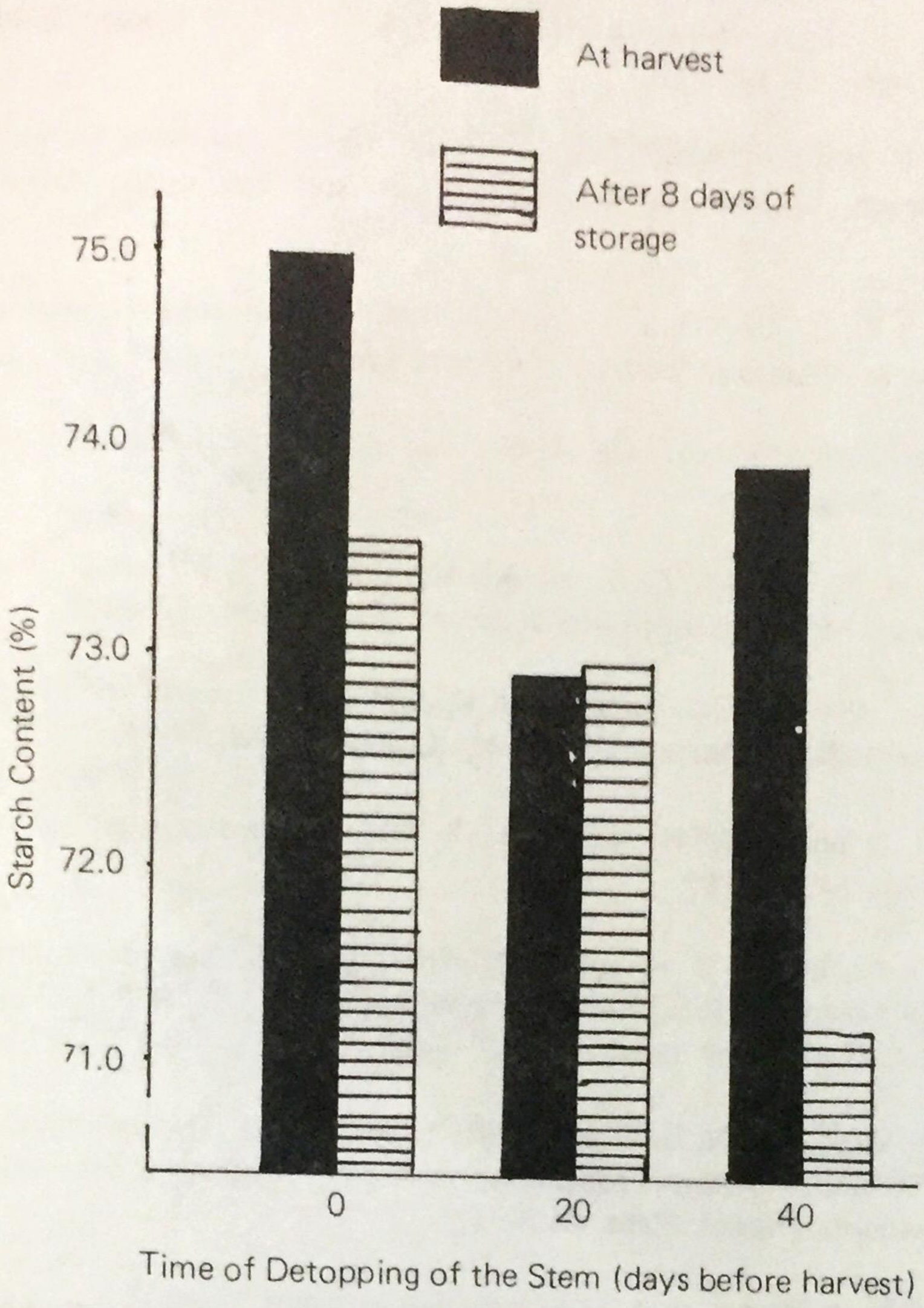

Fig. 8. Percent starch content (at harvest and 8 days after storage) of cassava tubers from plants detopped at 20 and 40 days before harvest regardless of the degree of detopping of the stem.

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