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# Studies to extend the dormancy of white yam (*Dioscorea alata* L)

*Maddineni M. Rao and Calixte George*[3]

## ABSTRACT

Two experiments were conducted in 1987-88 in St. Lucia with a view to extend the dormancy of white yam (*Dioscorea alata* L). Experiment 1 compared different harvest dates, different storage temperatures and presence or absence of the tuber "head" in cultivar Oriental. Experiment 2 studied the effect of gibberellic acid (GA) solution (1000 p/m) on the dormancy of different cultivars of white yam. Tubers from the early harvest (15 November) had the longest dormancy period (over 7 months), which decreased progressively with delay in harvesting. Storing yam tubers at 20 ± 2°C extended the dormancy by over 5 months as compared to storing them at 30 ± 2°C. The presence or absence of the tuber "head" had no effect. The interaction effects due to dates of harvest × storage temperatures and storage temperatures × manipulation were significant. Cultivars of white yam differed significantly in their dormancy period. Treating the harvested tubers with GA (1000 p/m) for 2 hours extended the dormancy by over 4 months as compared to that of the control (water) treatment.

## RESUMEN

### Extensión de la latencia en el ñame *Dioscorea alata*

En los años 1987-88 se hicieron experimentos en Santa Lucía para extender la latencia del ñame blanco (*Dioscorea alata*). El primer experimento incluyó diferentes fechas de cosecha, diferentes temperaturas y la presencia o ausencia de las "cabezas". El segundo experimento incluyó diferentes cultivares del ñame blanco tratadas con ácido giberélico (AG) o con agua (testigo). El producto de la recolección temprana (15 de noviembre) permaneció latente por más tiempo (más de 7 meses), pero se acortó progresivamente según se pospuso la recolección. El almacenamiento de tubérculos del ñame a 20 ± 2°C alargó la latencia más

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[3]Systems Agronomist and Project Manager, respectively, FSR/D Project, Caribbean Agricultural Research and Development Institute (CARDI), P. O. Box 971, Castries, St. Lucia, West Indies.

**des messes, más que el almacenamiento a 30 ± 2°C. La presencia o ausencia de las cabezas no tuvo ningún efecto. Los efectos de interacción debidos a las fechas de recolección y a las temperaturas de almacenamiento y éstas con la manipulación fueron significativos. Las cultivares del ñame blanco se diferenciaron significativamente en sus períodos de inactividad. El tratamiento de los tubérculos con 1000 p./m. de AG 2 horas después de la recolección extendió la latencia por 4 meses más que la del tratamiento con agua. El efecto de la interacción entre cultivares y AG o agua no fue significativo.**

## INTRODUCTION

Yam (*Dioscorea* spp.) is one of the most important root crops grown in St. Lucia for local consumption and for export. The most commonly grown species are *D. alata*, *D. rotundata*, *D. cayenensis* and *D. trifida*. In 1984, the Caribbean Agricultural Research and Development Institute (CARDI) began work with yam in St. Lucia with the objective of increasing production and improving crop management practices.

Improved cultivars of *D. alata* have been identified and recommended for commercial cultivation (5). However, peak production in yam is limited to a period of 3 to 4 months (December to March) after which time tubers start sprouting and consequently lose quality and market value. Since during the off-season yam demands higher prices, efforts toward the identification of cultivars having a longer dormancy and the development of techniques to prolong the storage of freshly-harvested tubers are worthwhile alternatives that benefit farmers.

There is considerable variation in the length of the dormant period in yam tubers, which depends on species and cultivar (6). The sprouting of yam tubers can be suppressed by storage at reduced temperatures. Exposure to low temperatures reduces the rate of metabolic activity, thus delaying the physiological changes which must precede the breaking of dormancy. Considerable extension of their shelf-life occurred when they were stored at 16 ± 1°C (4,7). However, storing tubers below 12°C after 4 weeks resulted in complete physiological breakdown.

In Trinidad, foliar applications of growth regulators on yam showed that gibberellic acid (GA) did extend the dormancy in cultivars of *D. esculenta* but not in *D. alata* (6). On the other hand, exposing tubers to methyl ester of naphthalene acetic acid (MENA) delayed sprouting in *D. rotundata*, *D. cayenensis* (1) and *D. alata* cv. White Lisbon (7). Prolonged exposures resulted in development of a warty surface, thus reducing tuber marketability. The dormancy in tubers of *D. alata* was extended beyond their natural dormancy by a post-harvest dip in GA (3,6,7). However, the effect depended on the time of treatment, concentration and duration of treatment, the condition of the tuber and stage of dormancy (7). Since yams are stored mainly during the dry season, considerable loss in weight of 20 to 30% is expected, depending upon the length of storage (1,2).

This study reports on the post-harvest management of yam tubers to prolong dormancy.

## MATERIALS AND METHODS

### Experiment 1

The cultivar Oriental (*D. alata*) was planted in April, May and June 1987 and harvested in November and December 1987 and January 1988, respectively. Uniform tubers of about 0.5 kg were selected from each harvest, washed free of soil and allowed to cure for 1 week. Three harvesting dates, two storage temperatures and tubers with and without head sections were arranged in a split-split-plot design with four replications. The main treatments were the harvesting dates of 15 November ($H_1$) and 15 December ($H_2$) 1987 and 15 January ($H_3$) 1988. The sub-treatments were the room temperatures of 20 ($T_1$) and 30 ($T_2$) °C with ± 2°C, and the sub-sub-treatments complete ($P_1$) and decapitated ($P_2$) tubers.

Each sub-sub-treatment comprised five (5) tubers. After recording their initial weights, we placed the tubers in banana boxes and transferred them to rooms kept at temperatures of 20 and 30°C. In each room, thermometers were installed to record the fluctuations in temperature.

### Experiment 2

Uniform tubers of cultivars Oriental, Belep, Kinabayo and Langie (*D. alata*) weighing 1 kg were selected, washed free of soil and allowed to cure for 1 week. After their heads were removed they were dipped in a 100 p/m solution of commercial bleach (NaOCl) for 2 minutes. The tubers were then submerged either in water (control) or a GA solution (1000 p/m) for 10 and 120 minutes, respectively. All tubers were drained dry and then stored in banana boxes at room temperature (30 ± 2°C). The experiment was laid out in a factorial randomised block design with four replications. There were five tubers to each treatment.

In both experiments, the date of initiation of tuber sprouting was monitored closely and the final weight of the tubers was recorded.

## RESULTS AND DISCUSSION

### Experiment 1

The date of harvest significantly influenced the post-harvest dormancy period of Oriental cultivar (table 1). Early harvesting (November) resulted in longest dormancy period (217 days), which decreased progressively with the delay in harvesting. In other words, Oriental tended to sprout at the end of its natural dormant period regardless of the month of harvest. These results are in agreement with those reported by González and Collazo de Rivera (4).

Storage room temperature also had a significant effect on sprouting (table 1). Lowering the storage temperature by 10°C extended the dor-

TABLE 1.—*Effect of different harvest dates, storage temperatures and manipulation practices on days to sprouting and percentage weight loss of yam (cv Oriental) tubers*

| Treatment | | Days to sprouting | Percent wt. loss |
|---|---|---|---|
| Dates of harvest (H) | | | |
| 15 November, 1987 | | 217 | 19.9 |
| 15 December, 1987 | | 203 | 16.0 |
| 15 January, 1988 | | 163 | 11.4 |
| S.E. | (d) | 3.6 | 2.0 |
| L.S.D. | (p = 0.05) | 8.8 | — |
| C.V. | (%) | 5.2 | 37.2 |
| Storage temperatures (T) | | | |
| 30 ± 2°C | | 109 | 9.2 |
| 20 ± 2°C | | 279 | 6.5 |
| S.E. | (d) | 3.1 | 2.1 |
| L.S.D. | (P = 0.05) | 7.0 | — |
| C.V. | (%) | 5.5 | 48.0 |
| Manipulation practices (P) | | | |
| Tubers with head | | 194 | 6.4 |
| Tubers without head | | 195 | 9.4 |
| S.E. | (d) | 3.1 | 1.7 |
| L.S.D. | (P = 0.05) | 6.5 | — |
| C.V. | (%) | 5.5 | 39.9 |
| Interaction effects | | | |
| H × T | | Sig[1] | N.S. |
| T × P | | Sig | N.S. |
| H × P | | N.S. | N.S. |
| H × T × P | | Sig | N.S. |

[1]Sig: significant; N.S.: not significant.

mancy period of Oriental by over 5 months. It is possible that the low temperature could have reduced the metabolic activity, thus delaying the physiological changes which must precede the breaking of dormancy. Earlier studies by González and Collazo de Rivera (4) and Wickham and Wilson (7) showed an extension in shelf-life of *D. alata* for up to 4 months when stored at 16 ± 1°C. The present study shows that a similar or greater extension in dormancy was possible even at 20 ± 2°C.

The presence or absence of the tuber 'head' sections had no significant effect on the dormancy period of Oriental; thus the mechanism of dormancy is controlled by growth regulators present in the whole tuber. Storing Oriental at normal room temperature (30°C) was found to be better only at the early harvest (November 1987), whereas the air-conditioned temperature (20°C) proved ideal for both the first and second harvests, i.e., November and December, 1987 (table 2). The effect of low temperature on dormancy in late-harvested yams was significantly

TABLE 2.—*Effect of harvest dates, storage temperatures on the number of days needed for the Oriental yam to sprout*

| Storage temperatures | | No. of days to sprouting — Harvest dates $H_1$ | $H_2$ | $H_3$ | Mean |
|---|---|---|---|---|---|
| | | 15 Nov 1987 | 15 Dec 1987 | 15 Jan 1988 | |
| 30 ± 2°C | | 129 | 105 | 93 | 109 |
| 20 ± 2°C | | 305 | 300 | 232 | 279 |
| Mean | | 217 | 203 | 163 | |
| S.E. | (d) | to compare table means: | 5.3 | | |
| L.S.D. | (P = 0.05) | to compare table means: | 12.0 | | |

lower, perhaps because physiological changes in the tubers had already started.

At room temperature (30°C) tubers with the 'head' section had a more prolonged dormancy period than those without the 'heads.' Conversely, air-conditioned temperature (20°C) extended the shelf-life of tubers without heads over that of those that were intact (Table 3). Post-harvest tuber weight was not affected by date of harvest, storage temperature or tuber manipulation practices.

## Experiment 2

Irrespective of the GA treatment, the Oriental cultivar had a significantly shorter dormancy period (table 4). It sprouted in only 153 days at room temperature. Cultivars Belep, Kinabayo and Langie averaged 191 days before sprouting. These results confirm the findings of Wickham and Wilson (7), who stated that shelf-life is limited to the length of the natural dormancy of the tubers.

Immersion of tubers in GA at a concentration of 1000 p/m for 2 hours extended the dormancy period by over 4 months as compared to the

TABLE 3.—*Effect of storage temperatures and tuber manipulation practices on the number of days needed for the Oriental yam to sprout*

| Storage temperatures | | No. of days to sprouting — Tuber manipulation practices: With head | Without head | Mean |
|---|---|---|---|---|
| 30 ± 2°C | | 112 | 106 | 109 |
| 20 ± 2°C | | 275 | 283 | 279 |
| Mean | | 194 | 195 | |
| S.E. | (d) | to compare table means: | 4.4 | |
| L.S.D. | (P = 0.05) | to compare table means: | 9.2 | |

TABLE 4.—*Dormancy period and percentage weight loss in yam tubers of four* D alata *cultivars treated and nontreated with gibberellic acid treatment*

| Treatment | Days to sprouting | Percentage weight loss |
|---|---|---|
| Cultivar (A) | | |
| Oriental | 153 | 17.1 |
| Belep | 191 | 16.2 |
| Kinabayo | 195 | 13.2 |
| Langie (control | 187 | 12.5 |
| S.E. (d) | 5.7 | 2.1 |
| L.S.D. (P = 0.05) | 12.3 | – |
| Dipping (B) | | |
| Water (control) | 120 | 15.2 |
| GA—1000 p/m solution | 243 | 14.3 |
| S.E. (d) | 4.9 | 2.8 |
| L.S.D. (P = 0.05) | 10.6 | – |
| C.V. (%) | 7.7 | 28.6 |
| Interaction (AXB) | N.S.[1] | N.S. |

[1]N.S. = not significant.

water control treatment. It is suggested that naturally occurring growth regulators are dormancy inducers in tropical yams, and a degradation system becomes operative at the onset of dormancy. GA treatment extends dormancy either by substituting for these growth inhibitors or stimulating their synthesis (6).

Post-harvest tuber weight was not influenced by cultivars or GA dipping treatments.

## PRACTICAL IMPLICATION

From the above studies, it is clear that the dormancy of white yam (*D. alata*) can be extended beyond 4 months by storing the tubers at 20 ± 2°C or by treating them with gibberellic acid after harvest, thus making the crop available as a food source through a considerable portion of the yam-growing period. However, selection of cultivars and the critical temperature for storage, as well as time and concentration of GA, need more thorough investigation.

## LITERATURE CITED

1. Campbell, J. S., V. O. Chukwueke, F. A. Teriba and H. V. S. Ho-A-Shu, 1962. Some physiological experiments with the White Lisbon Yam (*Dioscorea alata* L.) in Trinidad. III. The effect of chemicals on storage. *Emp. J. Exp. Agric.* 30: 335-44.
2. Coursey, D. G., 1967. Yams. pp 189. London: Longmans, Green and Co. Ltd.
3. Degras, L., 1987. Post harvest studies and quality of yams. A review. 23rd Annual Meeting CFCS, St. John's, Antigua, 23-28 August 1987, pp 1-10.
4. González, M. A. and A. Collazo de Rivera, 1971. Storage of fresh yam (*Dioscorea alata* L.) under controlled conditions, *J. Agric. Univ. P. R.* 64: 46-56.

5. Rao, M. M. and C. George, 1987. Evaluation of yam and yam-based cropping systems in St. Lucia. A paper presented at the Second Caribbean Regional Workshop on Tropical Root Crops held in St. Vincent and the Grenadines, 14-18 September, 1987. pp 1-17.
6. Wickham, L. D., H. C. Passam and L. A. Wilson, 1984. Dormancy responses to post-harvest application of growth regulators in *Dioscorea* species. 2. Dormancy responses in ware tubers of *D. esculenta*. *J. Agric. Sci., Camb.* 102: 433-36.
7. —— and L. A. Wilson, 1985. Harvesting, handling and storage of yams. CAEX-TB/2/85; pp 1-14.