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TEMPERATURE AS A MANAGEMENT TOOL FOR FUMIGATION IN CONCRETE SILOS IN THE CAPE VERDE ISLANDS

A. MAIA,[1] A. BARBOSA,[1] ANA PAULA PEREIRA,[1]* P. CARDOSO[2] and A. MEXIA[1]

[1]*Instituto de Investigação Científica Tropical, Centro de Estudos de Fitossanidade do Armazenamento (CEFA/IICT), 1300-142 Lisboa, Portugal*
*[*e-mail: apperiera@netc.pt]*
[2]*Empresa Pública de Abastecimento, Praia, República de Cabo Verde*

ABSTRACT

As part of a research project on quality maintenance of the strategic storage of food and animal feed grains on the Cape Verde Islands, preliminary results from the analysis of one year's data collected in one concrete silo in the Praia port terminal elevator at Cape Verde were presented in this poster. The current status of temperature control using aeration and fumigation in the 10,000 t reinforced concrete elevator consisting of 15 bins, was reviewed. Routine monitoring of the daily registered temperatures throughout the grain bulks provided information on how to optimise aeration schedules and improve storage conditions. This analysis will be extended to cover a 2-year period and another silo in Mindelo on S. Vicente Island.

INTRODUCTION

Cape Verde is an archipelago of ten islands located in the Atlantic Ocean, 750 km west of the Senegal coast. The islands, of volcanic origin, are relatively small with a total area of 4,033 km^2.

The climate is arid and semi-arid with a wet season from August to October and a dry season from November to July (Correia, 1992). The average annual rainfall ranges from 300 to 600 mm (Correia, 1998).

The country is largely dependent on cereals importing around 70-90% of its needs, with maize being the most important, and constituting 60-70% of all cereals imported. Maize for human consumption is mostly white flint and maize for animal feed is mostly yellow.

The storage systems comprise both bulk and bag storage. Two port terminal elevators on two different islands guarantee the reception in bulk from ships and storage in bulk for variable periods. Stores situated on all islands guarantee an additional storage capacity as well as provisions for handling in bags. The two port terminal elevators are located in Praia -the capital of Cape Verde- on Santiago Island, and the other in Mindelo on S. Vicente Island.

Temperature data recorded in the elevators is routinely analysed to guide decision-making on periodic grain aeration, while analysis of relative abundance of

insect infestations is used to determine when to apply chemical treatments such as fumigation.

The current status of temperature control by means of grain aeration, and of fumigation in the Praia elevator is presented here.

MATERIALS AND METHODS

The Praia port terminal elevator has a capacity of 10,000 tonnes. It is a reinforced concrete structure of 15 bins, 28.5 m high and 6 m in diameter (Fig. 1). The loading/unloading capacity is 120 t/hour, with horizontal handling by belt conveyors and vertical handling by bucket elevator. Each bin is equipped with a centrally mounted cable with five temperature sensors spaced at 5.2 m intervals (Fig. 2).

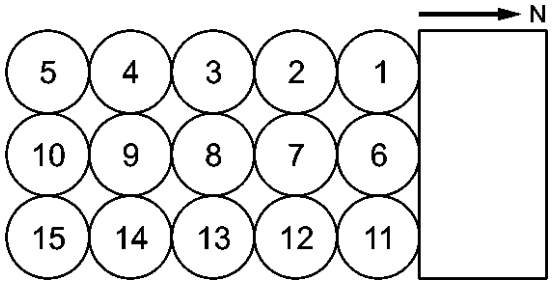


Fig. 1. Layout of the bins at Praia port terminal elevator.

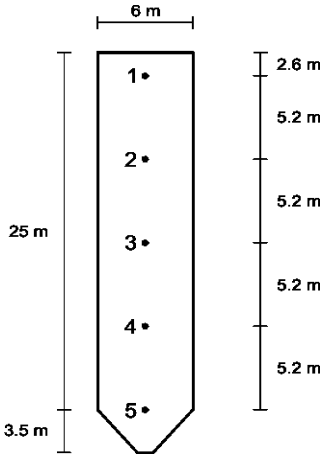


Fig. 2. Diagram of a bin and location of the temperature sensors.

A 5.5 kW centrifugal fan with an airflow rate of 5.5 $m^3 \cdot h/m^3$ and a static pressure of 2 kPa was used for aeration working in the blowing mode with an upward airflow. Temperature data were collected from the manual register that forms part of the daily routine monitoring procedure, and were converted to digital format. The period under analysis was a twelve-month period from January to December 1998.

RESULTS AND DISCUSSION

Moisture content

Maize for human consumption at bin loading revealed a moisture content (m.c.) of 12.5% or less. Maize for animal feed had values between 14 and 14.5% m.c.

Storage periods were very variable although maize for feed was stored for shorter periods than maize for human consumption (Table 1). Some 80% of stocks were stored for less than 120 days as against 37.5% of stocks for human consumption.

TABLE 1
Storage periods of maize in the Praia port terminal elevator, Santiago Island 1998, showing number of bins and percentage of total stock in brackets

Maize	Storage periods days / % of total stock				
	0-60	61-120	121-180	181-240	241-300
Human consumption	1 (12.5%)	2 (25%)	3 (37.5%)	1 (12.5%)	1 (12.5%)
Animal feed	10 (42%)	9 (38%)	5 (20%)	–	–

Temperature variation

The annual average air temperature at Praia is 24.4ºC, with an average minimum of 21.7ºC and maximum of 27.2ºC. The monthly average ranges from 22.2 to 26.5ºC.

The average in-grain storage temperatures were 27.4ºC and 30.0ºC for maize for human consumption and animal feed respectively.

Grain aeration

Fan characteristics were found to be in close agreement with the chart for shelled corn provided by Foster and Tuite (1982). Taking into consideration the values presented by Lasseron *et al.* (1994), they also fit the aeration requirement criteria albeit within the minimum values of the range.

Decisions on aeration are taken upon analysis of fluctuations in grain temperature, as well as evaluations of either routine or special grain inspections to determine condition and the relative abundance of insects. Most aeration operations took place during night time.

Figures 3 and 4 show typical situations of temperature variations during storage, and the aeration of maize for human consumption and animal feed.

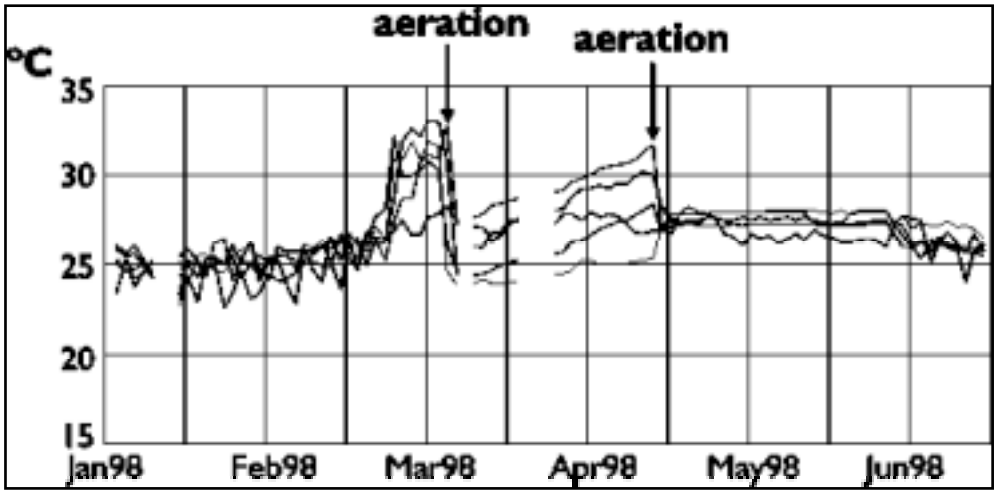
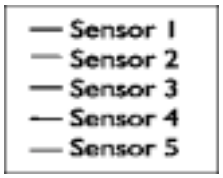


Fig. 3. Temperatures of maize for human consumption during the storage period.



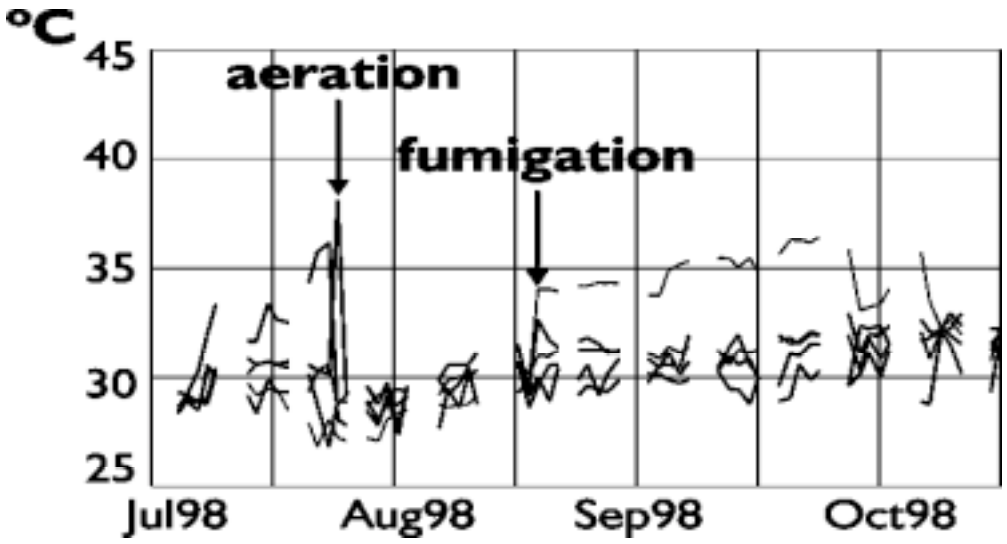


Fig. 4. Temperatures of maize for animal feed during the storage period.

In some aerations, the routine recording of daily temperatures enabled movements of the cooling fronts to be tracked (Fig. 5).

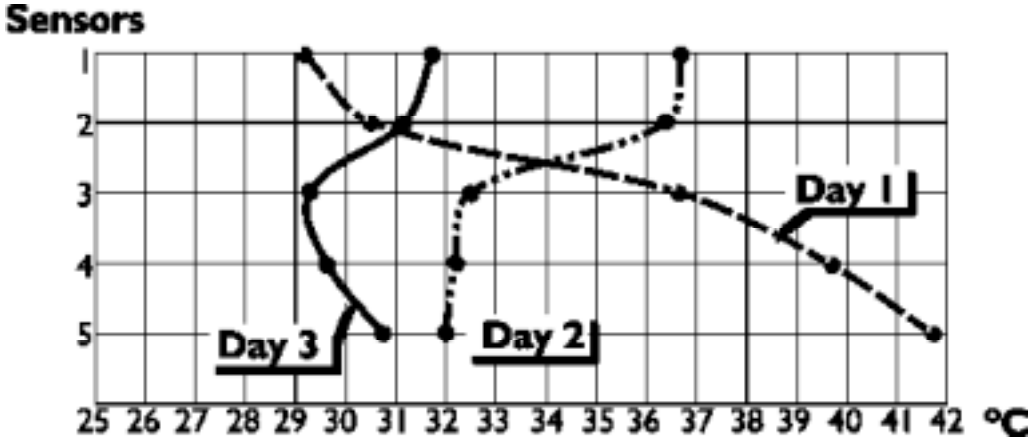


Fig. 5. Profile of the temperatures along the central axis of a bin on different days of aeration.

Fumigation

Magnesium phosphide formulations were used at appropriate dosage rates whenever the combined relative abundance of insects and temperature required such action to be taken. Depending on the situation, the fumigant dose was applied either at the bottom or the top of the bin or to the entire bin, for 72-96 h exposure periods. In some instances, translocation of grain from bin to bin, fumigation and aeration were applied in conjunction.

CONCLUSIONS

The considerably different m.c.'s between maize for human consumption and for animal feed of 12.5 and 14.5% respectively, determined to a large extent the duration of safe storage and consequently, the actual storage periods.

The practice of cleaning and separating broken kernels from the maize for human consumption at the beginning of the storage period proved to be a good criterion for maintaining quality.

Although temperature data were only recorded on a daily basis it was possible, in some aeration procedures, to follow the cooling front as it moved through the grain.

Fumigation, translocation of grain from bin to bin, and aeration made it possible to extend the safe storage period of the grain reserves.

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