

INFLUENCE OF RELATIVE HUMIDITY ON WEIGHT LOSS IN POTATO TUBERS STORED AT HIGH TEMPERATURE

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SUMMARY

Weight loss was determined in tubers of two varieties viz. Kufri Chandramukhi and Kufri Jyoti grown at Modipuram and Shimla and stored at three relative humidity (RH) levels of 30-35%, 60-65% and 90-95% with temperature maintained at 28-30°C. In dormant tubers, the weight loss was higher at 30-35% RH but once the dormancy was broken and sprout growth started, higher RH level favoured greater sprout growth leading to higher weight loss. The weight loss was more in tubers with uncured skin. Weight loss showed a non-significant relationship with number of sprouts per tuber, length of the longest sprout, surface area of tubers and periderm thickness.

Key words: High temperature, periderm, potato tubers, relative humidity, sprouting, surface area, weight loss.

INTRODUCTION

Generally potatoes are stored in India in cold storage at 2-4°C. While cold storage is suitable for long term storage of potatoes, it is not economical to store potatoes in cold store for a short period of 3-4 months. For short-term storage of potatoes several on-farm storage methods are practiced in the country and heaps and pits are more popular methods (Ezekiel *et al.* 1999). The temperature inside heaps and pits reaches a maximum of 28-30°C and the relative humidity varies between 38 and 66% (CPRI 1999). Weight loss in potatoes stored in heaps and pits is quite high which could be attributed to high temperature and low relative humidity. While some information is available on the effect of high temperatures on weight loss in tubers of Indian potato varieties (Ezekiel and Singh 2000), no information is available on the effect of relative humidity on weight loss in potatoes of Indian varieties. The aim of this study was to quantify the effect of different humidity levels on weight loss in potatoes stored at high temperatures of

28-30°C and to work out the relationship between sprout growth and weight loss at different humidity levels, in order to quantify the weight loss in potatoes stored in heaps and pits in relation to relative humidity.

MATERIALS AND METHODS

The effect of relative humidity on weight loss in potatoes was studied in two potato varieties viz., Kufri Chandramukhi and Kufri Jyoti grown in plains (Central Potato Research Institute Campus, Modipuram, AMSL 237m; 29° 4'N, 77° 46'E) and in hills (Central Potato Research Institute, Shimla, AMSL 2202m; 31° 06'N, 77° 10'E) during 1998-99. Recommended package of practices was followed for raising the crop and the tubers were lifted after the vines had reached full maturity. The plains crop was grown under short day conditions while the hill crop was grown under long-day conditions.

The tubers grown at Modipuram were harvested on 10-02-1999 and brought to Central Potato Research

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Institute, Shimla. Tubers were stored at room temperature until last week of April and then stored in BOD incubators maintained at 28-30°C and at three relative humidity (RH) levels (30-35%, 60-65% and 90-95%). For maintaining the RH, incubators with in-built humidity generation and control system were used.

Ten tubers of each variety were placed in plastic egg trays with the apical bud end upwards. There were three replications for each variety and humidity level. The tubers were checked at least twice a week for sprouting. Observations on weight loss per tuber, number of sprouts, length of the longest sprout and weight of sprouts were recorded at weekly intervals up to 42 days of storage. The weight loss included evaporation and respiratory weight loss of tubers and sprouts. Along with the trays, about one kg lots of these tubers were also kept in the incubators in three replications for observing the relationship between weight loss and surface area of tubers.

The tubers grown at Shimla were harvested in the third week of August and were stored immediately after harvest in BOD incubators maintained at 28-30°C and at 60-65% and 90-95% RH. Weekly observations were recorded on the weight loss of these tubers up to 13 weeks of storage. Statistical analysis was done using MSTAT (4.0C) package and the regression equations were obtained for weight loss as affected by sprout weight on per tuber basis.

RESULTS AND DISCUSSION

In tubers grown at Modipuram, weight loss was higher when tubers were stored at 30-35% RH as compared to 60-65% and 90-95% RH, in Kufri Chandramukhi. However, after 35 days of storage, the weight loss in Kufri Jyoti was observed to be higher at 60-65% and 90-95% RH than at 30-35% RH because of higher sprout growth in tubers stored at higher humidity levels. The differences in weight loss due to different humidity levels were more pronounced in variety Kufri Chandramukhi (Fig. 1). The degree of weight loss is known to be influenced by RH in the storage atmosphere and the variety (Samotus *et al.* 1973).

When tubers grown at Shimla were stored at 60-65% and 90-95% RH, the weight loss was more at 60-65% RH in both the varieties (Fig. 2). The quantum of weight loss

at a given RH was more in tubers grown at Shimla than those grown at Modipuram because the skin was not fully cured in tubers grown at Shimla at the time of storage. Tubers with uncured skin are known to lose more weight than well-cured tubers in storage (Booth and Shaw 1981). The rate of weight loss was quite high in tubers grown at Shimla during the first week and it declined subsequently (Fig. 2). The very high weight loss during the first week of storage could be due to the immature skin and delay in sufficient periderm formation. Burton (1989) and van Es and Hartmans (1987) also observed that in the absence of

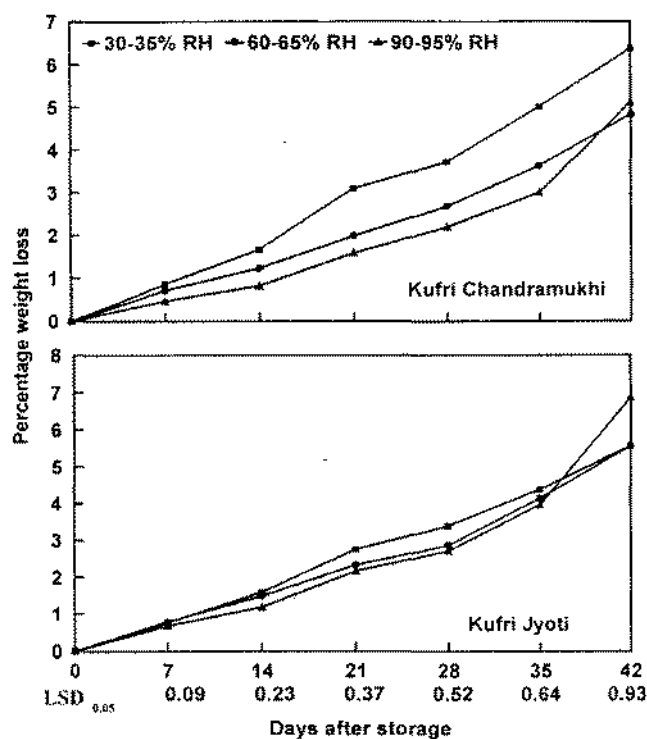


Fig. 1. Effect of different humidity levels on the weight loss (%) in potato tubers harvested from plains.

sufficient periderm formation, high water loss occurred immediately after harvest and the rate of water loss fell considerably during further storage.

Weight loss increases with sprout growth since sprout growth adds to the surface area of the tuber and high permeability of sprout wall to water vapour leads to greater water loss. It has been estimated that the surface area of sprouts equivalent to 1% of that of tuber could double the potential rate of evaporation (Burton 1955). The high weight loss observed at 90-95% RH between 35

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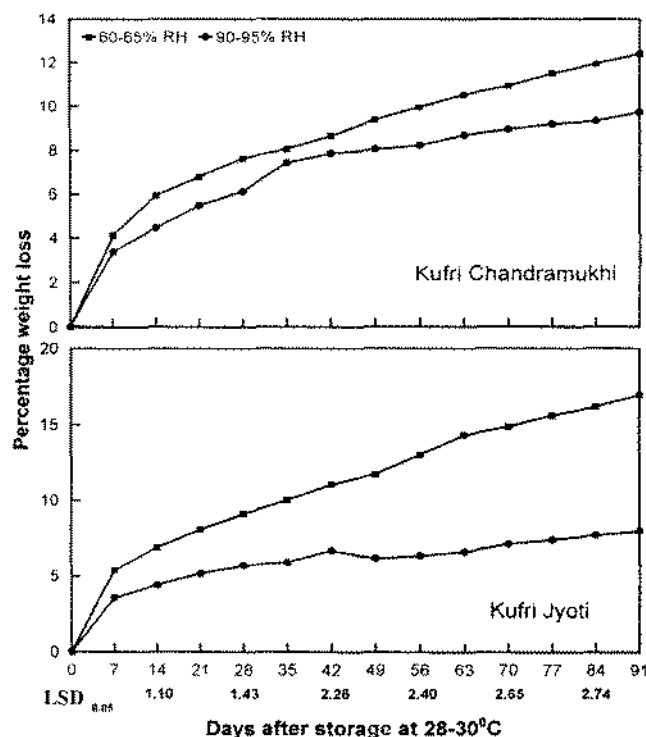


Fig. 2. Effect of different humidity levels on the weight loss (%) in potato tubers harvested from hills.

and 42 days of storage could be attributed to higher sprout growth leading to greater weight loss. However, weight loss showed a non-significant relationship with number of sprouts per tuber and with length of the longest sprout. In Kufri Chandramukhi, a positive linear relationship between sprout weight and weight loss was observed at 30-35% and 60-65% RH (Fig. 3). In Kufri Jyoti also the relationship were linear but the R^2 values were very low at these humidity levels. Burton and Hannan (1957) had shown an approximately linear relationship between sprout weight loss while Krijthe (1962) observed a clear-cut linear relationship between these two parameters. Ezekiel and Singh (2002), however, reported that the relationship between sprout weight and weight loss could vary with the variety and storage temperature.

The correlation between weight loss and number of sprouts, length of the longest sprout, volume of tubers, periderm thickness and surface area of tubers was non significant. Generally, large surface area of tubers is known to result in higher weight loss. Periderm thickness

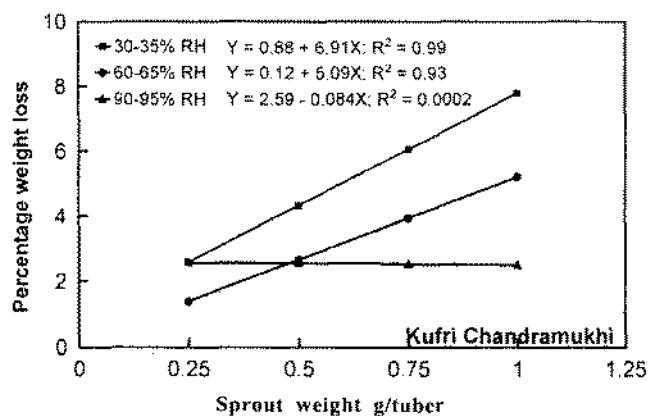


Fig. 3. Relationship between sprout weight (g/tuber) and weight loss (%) as affected by humidity levels in potato cv. Kufri Chandramukhi.

of a tuber also plays a major role in determining weight loss since 98% of the moisture loss could be attributed to water transport through periderm (van Es and Hartmans, 1987). Thicker the periderm lesser is the moisture loss. The periderm thickness in Kufri Chandramukhi was 151 μm and in Kufri Jyoti, it was 125 μm . In unsprouted tubers, the weight loss was lesser in Kufri Chandramukhi because of thicker periderm as compared to Kufri Jyoti. Thus varietal differences in weight loss in unsprouted tubers during storage could be attributed to differences in their periderm thickness.

Burton (1989) has reported that under drier conditions, the rate of evaporation from tubers increases, potentially in direct proportion to the increased water vapour pressure. Tubers are stored on-farm in heaps under drier conditions and the RH in heaps varies from 38 to 66%. At these RH levels, weight loss is considerable especially after the tubers begin to sprout and increases further when the sprout growth increases with time. Weight loss in on-farm storage methods like heaps could be minimized with proper curing of tubers and by using varieties whose tubers have thick periderm and longer dormancy duration.

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