Assessment of the Performance of Sun Drying of Maize Grains on Perforated Surfaces

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Abstract

Sun drying of maize grains on different mesh sizes of perforated trays using different heights from the ground was investigated. The mesh sizes used were 1.5 mm and 3 mm at the elevations of 30, 60 and 90 cm. The results show that both mesh size and height from the ground affect the drying rate and seed viability. The combination of 90 cm elevation and 3mm mesh size gave the highest drying rates and lowest seed viability loss.

Keywords: Sun drying, perforations, height from ground, maize

Introduction

Conventional sun drying usually involves direct exposure of crop produce to solar radiation at a reasonable depth. This method is the simplest and cheapest means of drying. However, it is associated with setbacks such as long drying periods required, vulnerability to pest attack and deterioration due to bad weather, e.g. rain and dust. The inherent long drying periods are due to periodical and intermittent nature of solar radiation. In Tanzania, the intermittency of solar radiation is more pronounced in the period around June-July. During this time the average insolation is about 600-700 cal/cm^2 or 25 - 29 MJ/m^2 (Colliver, 1991; Dejong, 1973; Duffie and Beckman, 1980; Loff*et al.*, 1966). Unfortunately, this is also the harvesting time for most field crops. Long drying periods may lead to mould growth.

Alternative drying methods that are superior to sun drying can be used to give fast drying rates and eliminate problems inherent to sun drying. However, such methods may be difficult to adopt in Tanzania and other developing countries due to the prevailing subsistence agriculture and overall poor economy. Under such circumstances, the emphasis has to be mainly on improving sun drying itself. This may include regular stirring of produce, drying in thin layers (1-2 cm) and drying on a perforated surface (Silayo, 1995). Bassey (1981) and Silayo (1995) have reported that the use of perforated surfaces gives significant improvement to sun drying viz-a-viz conventional sun drying on the ground. However, they did not analyse the effects of size of perforations and height of the drying floor from the ground. This paper investigates the effects of size of perforations and height of the drying floor from the ground on grain quality during sun drying on perforated surfaces.

Materials and Methods

Sun drying experiment was carried out in the Department of Agricultural Engi-

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neering and Land Planning - Sokoine University of Agriculture, using maize grain (*Staha cultivar*). Two levels of perforations namely 1.5 and 3 mm mesh size and three levels of heights namely 30, 60 and 90 cm were investigated. Due to the fluctuating nature of weather, all these combinations were tried on one day from 8.00 a.m to 5.00 p.m, during which solar radiation, relative humidity and temperature were recorded at the nearby meteorological station. Sun drying on the bare ground surface was the control experiment. Grain depth was maintained at about 10 cm, on a cross section area of about 2025 cm^2 (45 cm x 45 cm), guided by a wooden sided box with a depth of about 11 cm. Prior to sun drying, the grain was rewetted with tap water from moisture content of about 14% to about 22.50 % wet-weight basis, using the equation developed by Silayo (1995).

The response variables measured were grain moisture content and seed viability after drying. Moisture content was measured using the ventilated oven method at 130 ^0C for 38 hours (BS 4317: Part 15, 1981). Seed viability tests involved four replicates, each containing 100 seeds, put on a wet blotter paper and covered by another, in a germinator for seven days. The experiment was replicated twice, and the mean values for the response variables were plotted.

Results and Discussion

Figure 1 presents moisture contents attained after drying on trays with 1.5 and 3 mm square mesh at the heights of 30,60 and 90 cm from the ground. With 3.0 mm mesh size the final moisture contents attained were 13.73, 13.07 and 12.67 % wet-weight basis at the heights of 30, 60 and 90 cm, respectively. These moisture values were lower than those at the same heights and 1.5 mm mesh. For the whole combination of mesh sizes (1.5 and 3 mm) and heights (30,60 and 90 cm), the final moisture contents registered (Fig. 1) were lower than for sun drying on the ground, which gave moisture content of about 14.57% wet-weight basis. The implication of these results is that both the increase in height of the drying trays from the ground and the increase in mesh size give increased drying rates, as revealed by the decreased final moisture content. The effect of the difference between the drying rates of grains on the two mesh sizes was more pronounced at higher heights (60 and 90 cm) from the ground. The use of perforated surfaces resulted in lower moisture contents due to the effect of bulk natural convection of air through the perforations to the grain mass. The effect was more on the 3 mm (wider) square mesh, probably

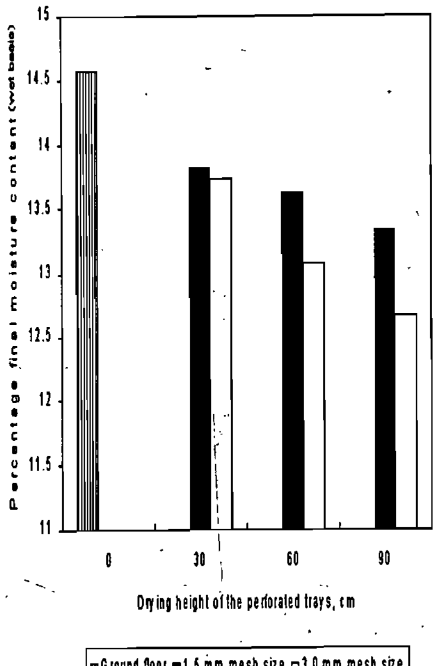

Figure 1: Final moisture content versus drying height of the perforated trays

due to less resistance to air movement through the mesh, implying that sun drying on trays with wider mesh are more suitable than those with narrow ones. The superiority shown by higher heights might have been caused by the availability of more bulk air below the trays.

Viability test results for the same run of experiments are presented in Fig. 2. These results show that drying at low heights on trays with small mesh size leads to low seed viability and vice versa. This is because high moisture content retention causes huge losses of viability. Seed viability results observed correspond well with the moisture profiles in Fig. 1, in which higher platform heights and large perforation are more beneficial.

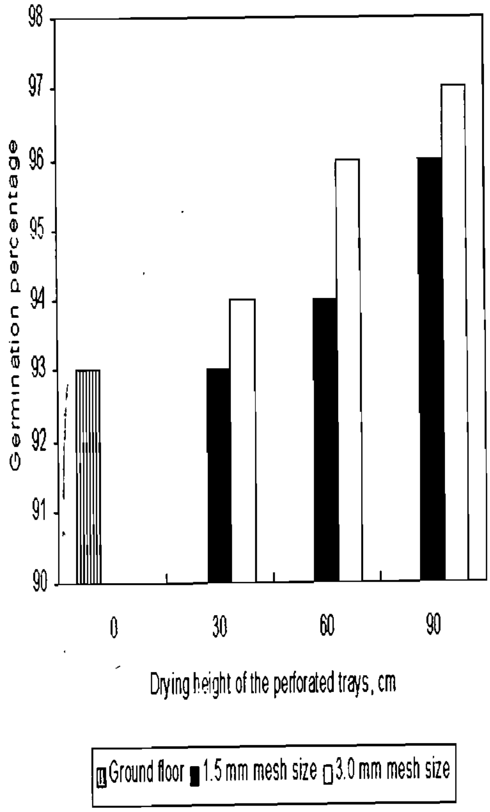

Figure 2: Germination percentage versus drying height of the perforated trays

Conclusions

As for moisture removal and maintenance of seed viability during sun drying, perforated surfaces are superior to unperforated ones. The use of perforated surfaces with large aperture size at higher heights from the ground increases the effectiveness of drying. More work is being carried out to include more levels of mesh size and height from the ground.

Acknowledgements

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