Assessment of weight loss in stored ginger (*Zingiber officinale* Rosc.) under different storage materials

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Abstract

Studies were carried out at Experimental Farm of ICAR- Indian Institute of Spices Research, Peruvannamuzhi, Kozhikode to find out the influence of green leaves and inert storage materials on physiological weight loss of seed ginger rhizomes stored in wooden storage units kept in semi-permanent shed. The storage unit with a capacity of 100 kg has wooden base of size 1× 1 × 0.1 m, above which side walls made of welded mild steel mesh is provided to a height of 30 cm in 27 different storage units. Ginger rhizomes treated with fungicide Mancozeb (0.3%) were kept in the storage unit and stored with green leaves such as *Glycosmis pentaphylla*, *Strychnos nuxvomica* and inert materials such as sawdust, sand and granite powder. Pre-treated rhizomes alone and untreated rhizomes served as control. Maximum percentage of bold healthy rhizomes with less moisture loss was obtained when rhizomes were stored with granite powder and sawdust (76.4%) and was on par with sand (74.2%). Influence of various storage materials on germination percentage of ginger rhizome showed that all the treatments except control was effective in maintaining the germinability (100%) of seed rhizomes. Studies on microbial infestation of stored rhizomes indicated that, storing ginger with *Strichnos nuxvomica* leaves showed pest/pathogen free seed rhizomes.

Introduction

Ginger (*Zingiber officinale* Roscoe.) is an economically valued spice crop used as vegetable and medicine. Owing to its warm pungent taste and pleasant odour, it is used widely as a flavouring agent in numerous food preparations, beverages, baked foods, confectionary, breads, soups, pickles and many popular soft drinks in common. Ginger is propagated vegetatively by the seed rhizomes and among inputs, seed materials alone accounts for about 40 % of total cost of production. The storage period of the seed rhizome for 3-4 months from harvest to next planting season is faced with many problems such as rotting, shrinking, sprouting and rooting resulting in huge losses. In order to avoid spoilage and to obtain good germination, proper storage of seed rhizome is essential. The ambient conditions during storage period is 22-25^0 C make the growing buds fat and strong and temperature higher than 28^{0}C in the long run make the buds thin and weak. If the storage humidity is too low, rhizome will wrinkle and sprouting speed and bud quality get affected (Xizhen *et al.* 2005). Spreading layers of *Glycosmis pentaphylla* (Paannal) leaves along with ginger rhizome is one of the methods practiced for reducing storage loss (Nybe & Miniraj 2005). Zero energy cool chamber (ZECC), is found ideal for storing fresh ginger. The loss in

weight of rhizome was only 23% after storing for four months in this chamber, while the ginger stored in open condition was shrunken in four months (Kumar *et al.* 2006). In Malabar area, cleaned rhizomes are smeared with a paste of cow dung and paannal leaves before storing to prevent scales and rotting. Beena et al. (1997) reported a seed storage practice consisting of seed treatment with Mancozeb (0.3%) and Malathion (0.1%) for 30 minutes, air drying and storing in pits lined with sand in thatched sheds or rooms where the temperature do not exceed 28°C. In another method, seed rhizomes are stored in pits in layers along with well drained sand/saw dust (Kumar *et al.* 2006). For storing large quantities of ginger rhizomes, neither pit nor zero energy cool chambers is sufficient. Hence 27 storage units with each having a capacity of 100 kg, with wooden base of size 1 x 1 x 0.1m, above which side walls made of welded mild steel mesh provided to a height of 30 cm were made for a total capacity of 2.7 tons.

Storing ginger rhizomes with *Glycosmis pentaphylla* is being practiced by several farmers in Kerala but moisture loss is high. Storing ginger with sand and sawdust is recommended (Kumar *et al* 2006) but the availability is scarce AS sand is very expensive. Keeping this in view an experiment was planned to find out the influence of green leaves and inert storage materials on physiological weight loss of ginger stored in wooden storage units kept in semi-permanent shed.

Materials and Methods

The experiment was conducted at experimental farm of ICAR- Indian Institute of Spices Research, Peruvannamuzhi Kozhikode from 2009 - 2011. The experimental site is located at 11° 34' N and 75° 49' E with an attitude of 60 m above MSL. The experimental site has a typical tropical humid climate with bimodal monsoon rains, with an annual rainfall of 4500 mm per year. The mean maximum temperature varied from 25-37°C and the minimum temperature from 17.5-31°C during the experimental period. Average rainfall during February, March, April, May, June, July, August and September were 0, 22.4, 14.58, 28.46, 33.86, 68.50, 20.26 , 28.11 mm, respectively.

Twenty seven storage units made up of wood and mild steel mesh with a total capacity of 2.7 tons was used in the experiment. Capacity of single box is 100 kg. For this experiment ginger rhizome weighing 50 kg was used to fill the each storage unit. Each inert material and green leaves were spread to a thickness of 2 cm in a box over which ginger rhizomes were spread to a thickness of 25 cm and again covered with the storage materials. A space of 10 cm from the top of the box was left for ventilation and the ginger rhizomes were stored for a period of four months with different treatments. Care has been taken to reduce the temperature inside the shed below 28°C by providing shade below the roofing. Healthy, uniform sized rhizomes of ginger variety Varada were used for the study. Rhizomes were treated with fungicide Mancozeb (0.3%), dried in shade and stored with different storing materials. The experiment was designed in CRD with seven treatments and three replications. Treatments are storing treated rhizomes with T1- *Glycosmis pentaphylla*, T2- *Strychnos nuxvomica*, T3- Sawdust, T4 – Sand, T5 - Granite powder, T6 - Fungicide treated rhizomes alone, T7 - Untreated rhizomes alone (Control).

The weight of healthy, shrinked and infected rhizomes was recorded after 120 days of storage in each storage unit and expressed in percentage. The moisture loss in weight was found out by deducting weight of healthy, shrinked and infected rhizomes from total quantity used for storage. Rhizome samples stored under various storing materials were analysed for the microbial association both by microscopic observation of surface growth and by culturing in different media. After the storage period of 4 months, healthy rhizomes were planted in beds of 3 m × 1m size at a spacing of 25 × 25 cm to study the effect of storage method on sprouting. Observations on sprouting were taken per bed and expressed as percentage. The data recorded were statistically analyzed (Panse & Sukhatme,1985).

Results and Discussion

The effect of various storing materials on percentage recovery of healthy ginger rhizomes is presented (Table 1). There were significant difference between treatments; data indicated that maximum percentages of healthy rhizomes were obtained when stored in granite powder (76.62) on par with sawdust and sand. Lowest percentage recovery of healthy rhizomes was recorded by control (58.69).

Table 1. Effect of inert and green leaves on percentage recovery of healthy rhizomes, loss of moisture and germination

Treatment	Healthy rhizomes (%)	Shrinked rhizomes (%)	Infected (%)	Moisture loss (%)	Germination (%)
Glycosmis pentaphylla	61.50	11.15	17.00	10.17	100
Strichnos nuxvomica	58.33	11.03	16.50	14.17	100
Sawdust	71.17	8.3	13.67	8.00	100
Sand	70.83	8.8	15.83	7.00	100
Granite powder	74.30	9.0	13.67	5.50	100
Fungicide treated alone	55.80	12.90	16.83	12.0	100
Untreated alone	50.67	15.00	20.67	15.0	68.5
CD 5%	12.50	4.43	NS	4.33	NS

There was significant difference in the quantities of shrinked rhizomes with different storing materials used. Lowest percentage of shrinked rhizome was noticed with sawdust on par with sand, granite powder, *Glycosmis pentaphylla* leaves and, *Strychons nuxvomica* leaves storing. Highest percentage of shrinked rhizome was recorded in control.

Treatments in which inert materials and green leaves were used had less shrinkage and disease incidence, especially in the case of granite powder, sawdust and sand. Weight of healthy rhizomes was high under these treatments which show the significance of storage material to keep the surrounding at low temperature and then by reducing the moisture loss from rhizomes. For minimizing water loss from produce stored, the capacity of air to take up additional moisture from the immediate surroundings should be lowered and hence the storing material is used to reduce moisture gradient between the produce stored and its immediate surroundings. Principal aim of using storing material is to control shrinkage and prevent the undesirable physiological changes like transpiration, respiration and disease incidence. This could be achieved primarily by controlling the post-harvest environment such as maintenance of low temperature and high humidity (Khurdiya, 1995). Granite powder is a bad conductor of heat and provides better insulation. Percentage pore space of granite powder (48%) is high compared to sand (43%) which might have helped for better air circulation to keep the surroundings in cool condition to prevent moisture loss (Thankamani, 2011). As a result better recovery of healthy rhizomes was observed in the experiment.

Recovery of healthy rhizomes was also higher when rhizomes were stored with sawdust and sand. Maya and John (2000) observed less moisture loss in the case of Sapota stored with saw-

dust. Sand is the recommended storing material for ginger (Kumar *et al.* 2006). Storing rhizomes with dry sand was found to be the most effective method to reduce physiological loss of weight in ginger (Chandrappa *et al* .1997). This result agreed with the findings of Oti *et al* (1988) in ginger.

Influence of various storage materials on rhizome infection was not significant. However maximum occurrence was observed in untreated rhizomes. Lowest percentage of infected rhizomes was noticed when ginger rhizomes stored with *Strichnos nuxvomica*, sand, sawdust, granite powder as storing material. Saw dust as amendment reduced rhizome rot incidence in ginger.

Micro organisms associated with stored rhizomes during the study period are shown in Table 2. In most cases *Fusarium* sp. was observed on the cut surface of the rhizomes. On rhizomes stored with *Glycosmis pentaphylla*, *Aspergillus* sp. was found to be on the surface and *Rhizoctonia* growth was obtained while culturing. Ginger stored with *Strichnos nuxvomica* showed no surface growth or any other growth in the culture medium. Ginger stored with sand also had no fungal growth but mites were found on the rhizomes and bacterial growth was obtained on culturing. Ginger stored with sawdust and chemical treated rhizomes without any lining material had only *Fusarium* growth. In granite powder *Fusarium* was found on the cut surface with bacterial growth in the media. Ginger stored without any treatment had saprophytic nematodes along with *Pythium* and *Fusarium* in culture.

The result on moisture loss from rhizomes stored revealed that maximum percentage moisture loss was from control (15.0) on par with *Strichnos nuxvomica* leaves and treated rhizomes. Percentage of moisture loss was significantly lower when rhizomes were stored using granite powder on par with sand and sawdust. Among the green leaves as storage materials, maximum percentage moisture loss was observed in the case on *Strichnos nuxvomica* followed by *Glycosmis pentaphylla*. The increased moisture loss from rhizomes kept without any inert and green leaves may be attributed to higher rate of evapo-transpiration and other physiological process like respiration prevailed under this method. Temperature and water activity are the two most important physiological parameters which control the rate of decay of commodities in storage (Khurdiya 1995). Very low humidity in the storage space caused physical deterioration which occurs as evaporation loss and affects the texture of stored commodities resulting in shrinking and wilting.

Table 2. Micro organisms associated with rhizomes of ginger under storage

Treatment	Microscopy/ surface growth	Potato Dextrose Agar	Nutrient Agar	Cassaminoacid Peptone Agar
Glycosmis pentaphylla	*Aspergillus* sp.	*Rhizoctonia* sp.	Nil	Nil
Strichnos nuxvomica	Nil	Nil	Nil	Nil
Saw dust	*Fusarium*sp. (cut surface)	Nil	Nil	Nil
Sand	Mites	Nil	Bacteria	Nil
Granite powder	*Fusarium* sp.	Bacterial growth	Bacteria	Nil
Fungicides Treated rhizomes alone	*Fusarium* sp.	Nil	Nil	Nil
Untreated rhizomes	Nematodes (Saprophytes)	*Pythium, Fusarium*	Bacteria	Nil

Storage of ginger in pits without any lining material was not suggested due to rotting and decay losses (Dey *et al.* 1996).

Influence of various filling materials on germination percentage of ginger rhizome showed that 100% germination was seen in all the treatments where filling material was used. Germination percentage was lowest in the case of control (70.00) though it was not significant.

Conclusion

Recovery of healthy rhizomes was higher in storing ginger with inert materials and green leaves. Germination of the ginger rhizomes were higher when granite powder as filling material on par with sawdust and sand which are generally used for storing. Granite powder may be used as storing material for ginger in places where availability of sand and sawdust is scarce.

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