

Post-Harvest Losses – Use of Triple Layer Plastic Bag – An Innovative Eco-Friendly Low Cost Approach to Mitigate the Problem in Developing Countries

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ABSTRACT

Intensive crop improvement programmes has resulted in increased food grain production globally. The developing countries competed with developed countries in the race of food grain production. However, the handling and safe storage of the increased produce was effectively managed by developing countries due to adoption of high cost technologies. The same could not be reciprocated by the developing countries which led to increased post-harvest losses. The reason governing the problem are many but the main reason is low capital investment in this segment by the small and marginal farmers who are otherwise poor, lack of awareness and on farm sale of the produce by the poor farmers. The development of a low cost eco-friendly approach could mitigate this problem and probably could help the poor farmer to retain the produce for a shorter period of time that could fetch him best price for his produce. Maintenance of physical and biochemical quality parameters of the produce is must during storage to achieve it. The use of triple layer plastic bags which works on hermetic technology which impacts the respiratory mechanism of living organisms could be a best alternative in this direction. The out of research findings, advantages in using this technology and its suitability to the small and marginal farmers in the developing countries is reviewed.

Key words: Hermetic technology, Post harvest losses, Triple layer bag.

INTRODUCTION

India is known as an agrarian country, where one third of the total population depends on agriculture for their livelihood. India's food grain production is around 265 million tonnes during 2014-15 and it is estimated that additional 150 million tonnes of food grain production has to be achieved to feed almost 1.5 billion people by 2040. The focused

approach on increasing the production of food grains primarily with the use of HYV, chemical fertilizers and pesticides has yielded positive results which made Indian food grain production from chronic food deficit to a surplus. However, the objective of reducing the storage losses by plugging the gaps through adoption of fundamental practices still needs to be intensified.

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The post-harvest losses in India amount to 12 to 16 million metric tons of food grains each year, an amount that the World Bank stipulates could feed one-third of India's poor. The monetary value of these losses amounts to more than Rs. 50,000 crores per year¹³. A more recent estimate by the Ministry of Food and Civil Supplies, Government of India, has put the total preventable post-harvest losses of food grains at about 20 million tons a year, which is nearly 10 per cent of the total production. Though the statistics show that post-harvest losses are constant at 10% of total food grain production but in actual they are steadily increasing with increase in food grain production which is quite alarming.

The prime reasons for such a huge loss of food grains can be attributed to

- 1) India being subtropical in its climatic with high relative humidity coupled with warm temperature making environment a conducive for insect multiplication.
- 2) The increased food production leading to increased storage losses shows that India do not have sufficient handling and storage facilities
- 3) Majority of the farm holdings are small, the level of production is low, quantity of storage is low and the methods followed for storage is also poor, which are the focal points for the initial pest infestation.
- 4) The technical moisture level for safe storage of food grains is not followed due to various reasons such as untimely rains and abnormal weather conditions particularly during harvesting and misconception of loss in grain weight due to continuous drying.
- 5) Majority of Indian farmers store their produce in gunny bags of 50 -100 kg capacity every year which have latent infestation.

RESEARCH

The research work on pest management in storage was aimed on aspects relating to prevention of entry, establishment and multiplication of pests in stored produce. Based on the above mentioned gaps much work has been done from time to time by

ICAR, SAU and other research institutes which include

- 1) Designing the improved storage structures like Pusa Bin, PAU Bin and HapurTekka etc. to avoid storage losses at the farm level.
- 2) Increased awareness to farmers through trainings about the adoption of technical moisture level for safe storage of food grains.
- 3) Use of Solar and improved driers for to attain safe storage moisture levels
- 4) Use of different biorational approaches like clay minerals, botanicals, light traps, sticky traps, pheromone traps etc. to monitor and manage pests

Though extensive research is being done in the field of storage entomology the generated technologies have not shown remarkable reduction in storage losses except high cost involved technologies (silos) whose adoption is difficult and is not economically feasible to the Indian farmer.

However, a new and upcoming technology which works basically on the principle of basic requirement of any living system i.e., respiration is hermetic technology where in the primary requirement i.e., availability of oxygen to a living system is targeted.

THE TRIPLE LAYERED PLASTIC BAG

The triple layered plastic bag consists of three plastic bags: two 80-mm high-density polyethylene (HDPE) bags, one surrounded by the second; both enclosed by a third bag made of woven polypropylene. The polyethylene inner bags have finite oxygen permeability and it greatly hinders oxygen leakage into the bag from the surrounding air. The woven outer bag is of that of a commonly used for grain storage bag. The grain is put into the inner HDPE bag and is then tied shut with twine or string. The second (middle) bag, enveloping the first, is then tied shut in the same way such that it completely surrounds the inner bag. The outer woven bag is then tied shut completely surrounding the inner two bags.

HOW DOES A TRIPLE LAYER PLASTIC BAG WORKS

The triple layer bag works only on physical properties, it was non- chemical method by means of death of insects was obtained by creating modified environment as depleted levels of oxygen and toxic levels of carbon dioxide, which create the harmful environment to development of insects and fungi during storage⁷.

The triple layer bag avoids the growth of living organisms by avoiding the diffusion of gases from outside to inner side of the bag. The insects/ fungi inside the bag utilize the oxygen content for their normal mode of living by releasing the carbon dioxide, but the expiration of carbon dioxide out of the bag was not possible due to triple layer structured bag. Hence, the death of insects and multiplication of fungi was avoided due to hypercarbia (Increase levels of carbon dioxide) and hypoxia (depletion levels of oxygen) conditions¹⁷.

RESEARCH RESULTS

The results of research conducted in various post- harvest produce targeting different insects have shown positive and encouraging results in most of the under developed countries especially in sub- Saharan part of Africa.

Hell *et al.*⁸ observed 100 per cent mortality of maize storage pests *P. truncates*, *Sitophilus zeamais*, *Cathartus quadricollis* and *Tribolium* sp when slightly infested maize seed from field was stored in triple layered bags for a period of six months⁸. Apart from killing the infested insects the triple layered plastic bags were found to protect the seed embryo which was evident by the work of Omondi *et al.* (2011)¹¹ who reported that the seeds stored in triple layer plastic bags maintained the germination percentage upto 85 per cent when stored for a period of 9 months, compared to traditionally used storage gunny bags where the germination percentage was reduced to 14-76 per cent within 3 months¹¹.

The triple layer plastic bags were also found to protect the seed weight was suggested by the studies of Baoua *et al.*⁵ who found no

significant loss in seed weight of cowpea stored for five months compared to the same produce stored in woven bags where a 40 per cent loss in seed weight was observed. Similar results were obtained by Anankware *et al.*² while working with maize stored in triple layered storage bags against the insect *S. zeamais*.

Several other research workers *viz.*, Murdock *et al.*¹⁰ Baoua *et al.*³, Sudini *et al.*¹⁴, Affognon *et al.*¹, Cugala *et al.*⁶, Sarr *et al.*¹² and Martin *et al.*⁹ opined the similar positive results working with different stored produces against different insects.

Apart from insects the storage of harvested produce without proper drying attracts infestation of molds in produce. Sometimes the insects infesting the produce pave ways for entry and development of fungi which can be described as secondary infestation. This sort of secondary infestation as mold development often results in release of mycotoxins as its metabolites which rapidly deteriorate the produce and make it unfit for consumption either for humans as well as for cattle.

Research conducted in this direction also yielded positive results that the produce stored in triple layered plastic bags could restrict the fungal development and mycotoxin¹⁶. Significantly less aflatoxin development was recorded by Sudini *et al.*¹⁴ when groundnut infested with bruchids was stored for a period of four months in triple layered plastic bags compared to cloth bags. The results were again confirmed by Williams *et al.*¹⁸ and Baoua *et al.*⁴ who found low levels of aflatoxin B1 in maize stored in triple layered plastic bags.

The researchers have also found that no significant reduction of biochemical constituents such as proteins, fatty acids were found to the produce stored in triple layered plastic bags¹⁵.

ADVANTAGES OF STORING PRODUCE IN TRIPLE LAYERED PLASTIC BAGS

- 1) Eco –friendly as it does not involve use of insecticides for managing the infested insect pests

- 2) Low cost compared to jute bags, affordable by the small and marginal farmer
- 3) Durable and hence can be reused if handled properly
- 4) Triple layered bags do not give scope for latent and cross insect infestation of stored produce
- 5) Do not affect the seed germination
- 6) Do not affect the biochemical constituents of stored produce
- 7) Do not give scope for development of mold and mycotoxins

CONCLUSION

Based on the above research findings and considering the economic situation of small and marginal farmers, the technology can be best adopted in all the developing countries of Asian subcontinent including India. The research in post-harvest management should be directed to customize the technology which can be best used by small farmers in rural India. Designing of triple layered plastic bags at low cost should be promoted which can facilitate as a means of employment in rural areas. Extension activities should be directed towards spreading the concept of hermetic technology and motivating the farmers to use it for short term storage of their harvested produce.

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