Journal of Maize Research and Development (2015) 1(1):98-105

ISSN: 2467-9305 (Online)/ 2467-9291 (Print)
DOI: 10.5281/zenodo.34288

Survey on maize post-harvest losses and its management practices in the western hills of Nepal

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ARTICLE INFO

Article history:
Received:
11th September, 2015
Revised :
12th October, 2015
Accepted:
16th November, 2015

Keywords:
Maize, Weevil, Infestation, Storage, Post-harvest losses

ABSTRACT

A survey was conducted in order to assess the losses of maize under farmers' storage conditions in the Western hills of Nepal in 2014. The survey area included Thanapati Village Development Committee (VDC) of Gulmi, Aalamdebi VDC of Syangja, Khasauli VDC of Palpa and Baglung municipality-12, Baglung district. Primary information was collected through semi-structured questionnaires among the heterogenous groups of the farming communities. Survey revealed that about 61% respondents reported the storage pest as the major pests and about 12% respondents reported that field pests as the major pests in the western hills. Maize weevil (*Sitophylus zeamais* Mostsch.) and Angoumois grain moth (*Sitotroga cerealella* Oliv.) were found to be major storage insect pests in surveyed areas. Majority of respondents (39%) presumed on 10-20% losses during storage. Among the other biotic factors, farmers ranked insect (42%), weeds (32%) and diseases (17%) respectively. Maize storage methods had distinct among the surveyed areas compared with Baglung district to other surveyed areas. In Baglung, about (73%) farmers had stored maize in the form of grain whereas in Palpa, Gulmi and Syangja, about (77%) farmers had practice of storing maize with husk for 5-7 months. Approximately, 40% respondents were using open floor in upper stair "Aanti"as a major maize storage place in Palpa, Gulmi and Syangja whereas almost (79%) of respondents were using sacks to store shelled grains in Baglung. Hence, there is ample opportunity to reduce the storage losses of maize depending upon the existing situation.

INTRODUCTION

Maize (*Zea mays* L.) is the second most important staple food crop after rice and a major food crop in the hills of Nepal (Upadhyay *et al.*, 2007). In tropical developing countries, a large proportion of the maize crop is harvested under humid and warm climatic conditions and most small farmers lack equipments for drying grains (Mettananda *et al.*, 2001). Apart from other factors, insect/pests and diseases have been playing a significant role in reducing

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production and productivity coupled with germination potential (Manandhar and Shivakoti, 2000).Among insect pests, maize weevil (*Sitophyllus zeamais*) and Angoumois grain moth (*Sitotroga cerealla*) were the most important insects in stored maize in Nepal (Sherpa *et al.*, 1997, G.C., 2006). Post-harvest losses were particularly problematic under the maize-based system in the hills of Nepal (Ransom, 2000). The storage of shelled grains is not a common practice in the Eastern hills. Majority of households in Eastern region store maize ears (cobs) on vertical wooden or bamboo frames outside the house (Thangro/Suli) and some households store the maize ears inside the upper room or loft of their houses, the ears being heaped into a regular shape with no material support (Kuniyu) (Bajracharya *et al.,* 2007). In general, maize was stored on Thankro/Suli, hanging on ropes, Kuniyu, and Dehari (Manandhar and Shrestha, 2000). K.C. (1992) reported that in Nepal, post-harvest losses in cereals was about 15-20%. Pradhan and Manandhar (1992) reported that the losses in storage were 8%, 7.4% and 13% respectively in Mountain, Hills and Terai of Nepal. Boxal and Gillet (1980) recorded 5.5 % average weight loss due to weevil attack in the Eastern hills of Nepal. Khanal *et al.*(1990) estimated maize storage loss of 10.6% due to weevils in Pakhribas conditions. However, Paneru *et al.* (1993) found storage losses of up to 32% due to the maize weevil. Similarly, based on the examination of several maize cobs stored in a Thangro for a period of 8 months, Golob (1994) found infestation levels of between 50 to 100% by *Sitophilus* weevils. Manandar and Mainali (2000) reported that insect incidence was highest in Thangro/Suli as compared to other structures. Ghimire *et. al.* (1996) indicated that the loss in terms of weight of up to 20% in a typical post-harvest storage situation. According to Sah (1998) the level of weevil infestation varied from 51.1 to 97 .0% in the mid altitude (1500 masl) to low altitude (750 masl) irrespective of yellow or white maize when stored in a Kuniyu (heaping of cobs) for a period of 5 months. Shivakoti (1981) reported an infestation level of up to 49% by *Sitotroga cerealella* and weevils stored in Thangro/Suli for a period of 6 months. The weight loss varied from less than 1 to 6% in different years. Pradhan and Manandhar (1992) reported the total loss of cereal grain from rodents was 44.3% on a national basis and in maize alone is about 21.5 % in the mountains, hills and terai regions. The post-harvest molds such as *Penicillin* and *Aspergillus* also cause about 1 to 5% losses in maize depending upon the time of maize harvest, duration of storage and it's conditions (Manandhar and Batsa, 2000). These molds besides deteriorating the grain also produce aflatoxin which would carcinogenic to man and animals. The majority of farmers and concerned organizations are tend to concentrate their efforts on the production aspect. While focusing on production, farmers tend to ignore the need for post-harvest loss minimization (Aulakh and Regmi, 2013). Gyawali (1993) reported that 50 plant species available in Nepal against insect pests in crops and stored grains. Among these plants, sweet flag stolen *(Acorus calamus*), neem *(*Azadirachta indica),oil, neem seed powder, timur (*Zanthoxylum armatum),* titepati *(Artimesia vulgaris)* have been reported to be superior in controlling the maize weevils (Paneru *et. al.,* 1996). Thus, this survey was designed to assess recent trend of maize grain losses during storage in hills of Nepal.

METHODOLOGY

The study was carried out in the mid hill districts of Thanapati VDC, Gulmi, Aalamdebi VDC, Syangja, Khasauli VDC, Palpa and Baglung municipality-12, Baglung. A total of 89 households and 4 different Community Based Seed Production (CBSP) groups were involved in the study. Primary information was collected through using semi-structured questionnaires among the heterogeneous groups of the farming communities. Key informants were interviewed directly visiting the individual household and focus group discussion was carried out with CBSP groups through using checklists. Available information on issues related to post harvest losses on maize during the period of the survey were study at best. Furthermore the information was based on interviews with farmers and not on actual measurements. Pair-wise ranking of each location regarding the post-harvest handling to maize grain storage and losses were comprised subsequently.

RESULTS AND DISCUSSION

1. Major problem in the maize field

Survey report revealed that 42% respondents ranked for insects as a main problem followed by 32% for weed and 17% for disease (fig 1). Among the insects, stem borer was major threat of maize in the field condition. Insect pests and diseases have been playing a significant role in reducing production and productivity of maize (Shivakoti and Manandhar 2000). They also reported that these organisms are responsible for decline in quantity, quality and germination potential of maize seeds in storage. Stem borer only causes 27-85% damage (Dhaliwal and Arora, 2001). The annual yield loss in maize because of weed problems was estimated to be approximately 10 % (Plessis, 2003).

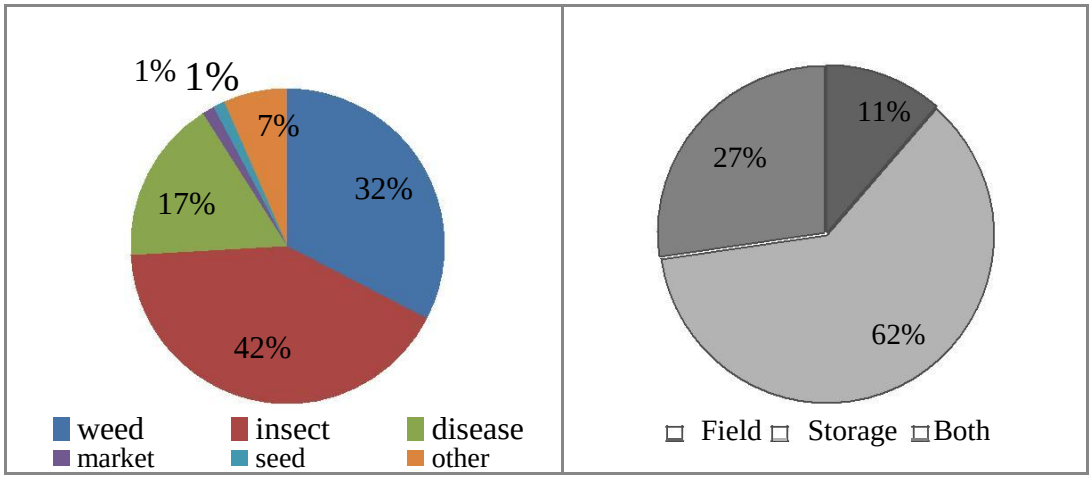


Fig 1:Major problem of maize production in the hil Fig 2: Grain losses at field and storage condition

At post harvest, 62% respondents were expressed their view on insects as a main problem in storage whereas field condition constraints indicated only by 11% respondents (fig 2). Maize was attacked by a wide range of insect pests both in the field and in the storage (Neupane *et al.,* 1991).

2. Storage insect-pests and farmer's perception

Farmers in survey area reported that weevil appeared just after harvesting in some cobs that is the source of infestation and it was found in increasing trend in recent years. Nearly all of the important insect pests of stored products are either beetles or moths. Both rodent and insect pests were more or less equally threat in storage in survey area (fig 3). The losses caused by diseases were negligible in survey area and very few farmers pointed out the problem of disease during storage. K.C. (1987) reported that maize grain loss due to rodents, insects, and mold to be 4.6, 3.1 and 0.2% respectively. Maize weevils alone cause up to 32% losses in storage (Panthee *et al.*,1993), 20-25% due to insects, rodents, mites and others, 15-20% losses reported by KC (1992).

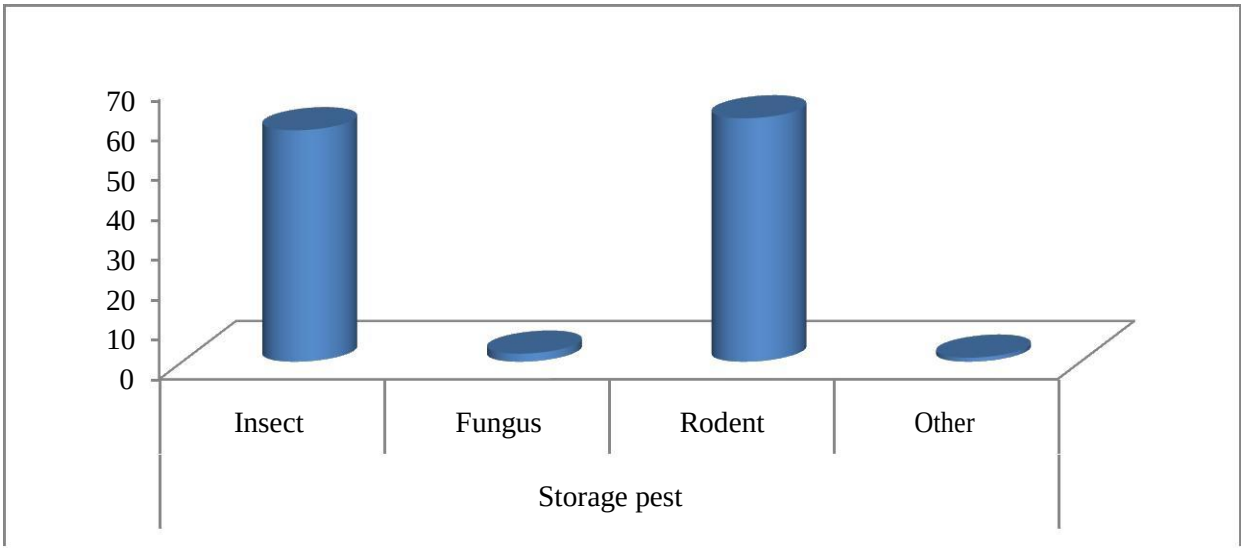
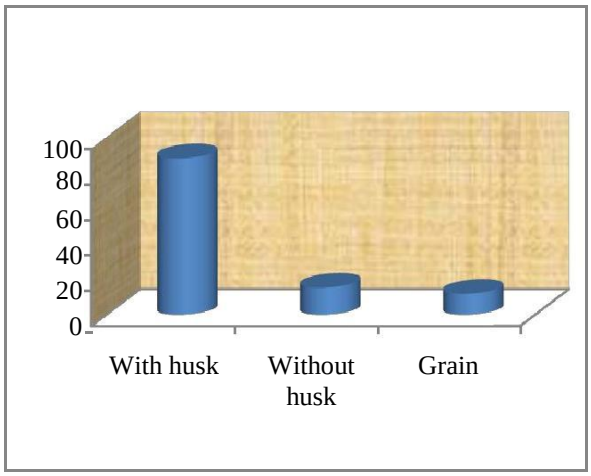


Fig 3:Major insect/pests in maize storage

3. On farm maize storage system

Nearly 40% respondents were using open floor in upper stair "*Aati"*as a major maize storage place in Palpa, Gulmi and Syangja, whereas (79%) were using sack to store shelled grains in Baglung (fig 4). Maize cobs stored in the local storage structures such as open storage, semi open storage or closed storage were found to be heavily infested by insect pests in the mid and high hills of Nepal. But in mid hills of Nepal, maize cobs are stored on Thankro/Suli, hanging on ropes, Kuniu and sundried mud structures (Dehari) (Manandhar and Shrestha, 2000). Nearly 80% farmers in Tanahun stored maize in "Kuniyu" a semi-open maize storage system (G.C., 2001). Metal bin was found superior in terms of its ability to give 91% germination within six months of storage followed by jute bag (88 %) and bamboo mat (73.50%) respectively (G.C., 2006).



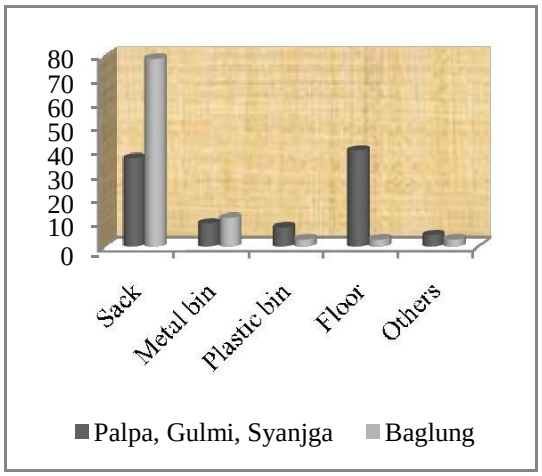
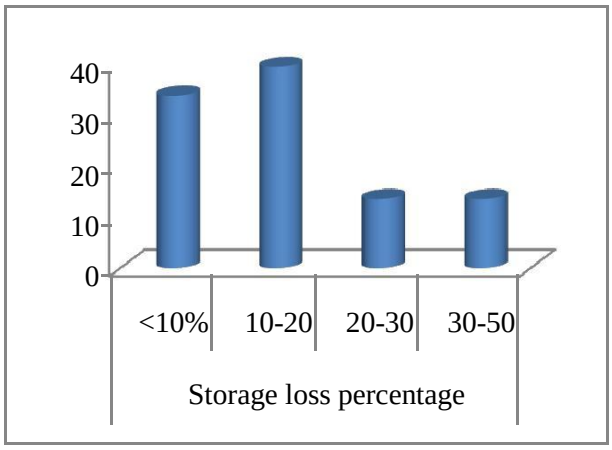


Fig 4:Maize storage methods in mid hills of Nepal

Fig 5: Maize storage devices used in surveyed areas

4. On farm losses of maize

The survey revealed that majority of respondents (39%) found 10-20% losses during storage (fig 6). Similarly, G.C. (2001) reported that 30-35% loss the grain especially in those ear which are stored in Kuniyu. 15-20% (K.C, 1992), 32% (Paneru *et.al.*, 1993), 40-50% (Manandhar, *et al.*, 2001) and Manandhar and Mainali (2000) reported (7.44%) losses in maize storage. Post harvest loss may occur during harvesting, transportation, drying, threshing, processing and storage. However, losses during storage have been widely recognized (G.C., 2000).



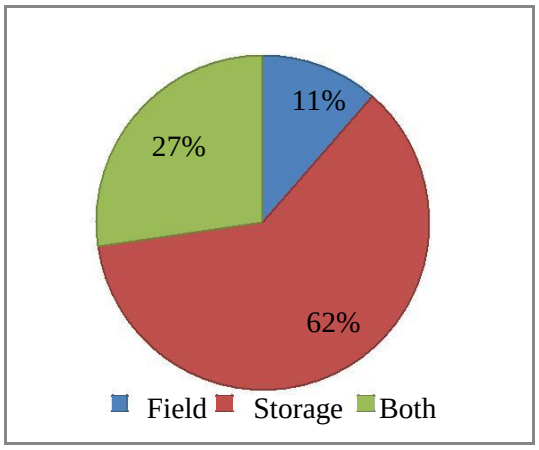


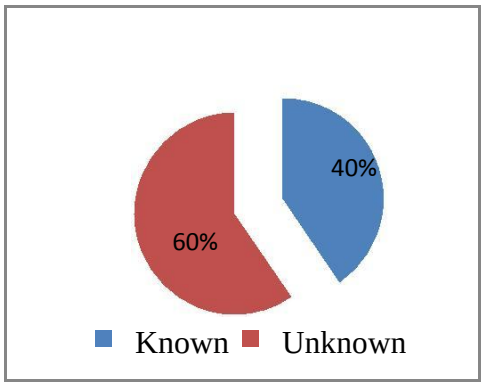
Fig 6:Maize grain storage losses in surveyed area conditions

Fig 7: Losses of maize in field and storage

5. Awareness of moisture percentage of grain during storage

In survey areas, only 40 percent respondents were aware of the role of moisture content in grain for the storability (fig 8). Similarly, 92% of the respondents expressed that emergence of insect occurred within 4 months after storage of maize grains (fig 9). In addition to seed moisture, storage temperature and relative humidity were considered highly important in safe storage of maize seeds. The rate of growth of stored pests, chemical and physical changes increased greatly by the moisture content as well as with ambient temperature. It is reported that the moisture content and temperature of the stored grain if go higher than 13% and 70^0F (21^0C), respectively,

grain in storage starts deteriorating rapidly. Harrinton, (1972) reported that for each 1% moisture in seed moisture content or 5^0C reduction in storage temperature, there is a doubling of storage life. So, the role of moisture percent is very important for the management of storage pests. Farmers do not follow preventive measures such as reduction of the moisture level by drying (G.C., 2001).



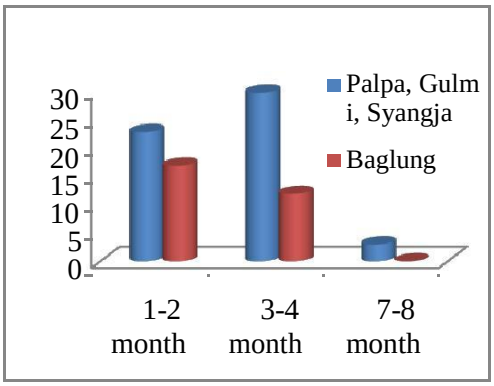


Fig 8:Farmer's perception on moisture percentage *Fig 9:Emergence period of insect pests in maize storage*

6. Pest management system at farmer level

Majority of the households in Palpa, Gulmi and Syangja did not use chemical pesticides and improved seed bins as compare to Baglung district. Celphos (zinc phosphide) was used by 30% respondents, 11% used improved seed bin whereas 23% used botanicals against storage pests. Pest management is a decision-making process that leads to pests being controlled in a cost effective manner. Sun drying was only the way of pest management practices in these region. Among the bio-rational plants product, Sweet flag stolen *(Acorus calamus*), Neem oil, *(Azadirachta indica*), Neem seed powder, Timur (*Zanthoxylum armatum)*, Titepati *(Artimesia vulgaris)* have been reported to be superior in controlling the maize weevils (Paneru *et al.*, 1996). In suli, 10% farmers use some barriers such as leaf of pine, dalle kuro, babio, red and white soil to prevent the rat invasion.

CONCLUSION AND RECOMMENDATION

On the basis of the survey result, insect pests were major problems during storage than field condition in the surveyed areas. The main causes of post-harvest losses in survey areas was traditional methods of storage. Most of the farmers stored maize cobs with husk in upper stair "Aati" for 5-7 month in Palpa, Gulmi and Syangja district but sacks and metal bins in Baglung district to store the shelled grain. Less than half of the respondents were aware of moisture content and its role on seed storability. Maize grain or seed loss in storage range were 10-20%. Sun drying was the pest management practices and very few farmers used chemicals insecticide and botanicals against storage pests. Important causes for low adoption of recommended post-harvest technologies were economical and social. Therefore, need to be design and development of appropriate post harvest loss reduction technology for the hills farmers. There is an ample opportunity to reduce the storage losses of maize by improving the farmer's storage systems and through the adoption of preventive measures as an integrated package.

ACKNOWLEDGEMENTS

The authors are highly indebted to NARC and NMRP for their technical and financial support. Technical staffs of NMRP and collaborating farmers of Western hills are also highly acknowledged.

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