# The Effect of Seed Source and Post-harvest Practices on Quality of Soybean (*Glycine max*) Seeds in Busia County

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**Abstract**

Majority of farmers growing legumes use and recycle seeds from informal sources for the next crop. The quality of such seeds is unknown and usually leads to accumulation of pest, diseases and reduced yields. This study was carried out to determine production practices and quality of soybean seeds obtained from informal sources in Busia County. A survey was conducted to collect information on source of soybean seeds, production and post-harvest handling practices. Seed samples were collected from farmers, local market and agro-dealers. The seeds were evaluated for purity, seed coat damage, germination, vigour and fungal infection. Majority (48%) of farmers in Busia County used farm saved seeds, 29% and 23% used seeds from community based organizations and local markets, respectively. Most of the farmers (92%) used inappropriate threshing techniques like beating with sticks and about 80% of the farmers did not treat seed either before storage or during planting. Majority (68%) stored soybean for three months only. Seeds from informal sources had low purity, higher seed coat damage and infection as compared to certified seeds. The physical purity of seeds from the informal sources did not meet the recommended standard of 98% however their germination was comparable to 75% germination standard. Farmers therefore, should be advised to adopt use of certified seeds and appropriate handling techniques.

**Keywords:** Soybean, seed source, seed quality, seed production practices

## Introduction

In Africa, seed that is used is supplied by formal and informal seed sector. According to Adetumbi *et al*. (2011) 100% of the seed dealers handle maize, 82% for cowpea and 82% vegetables compared to 27% for soybean seeds indicating a limited supply of soybean seeds compared to other grain crops and vegetables. The informal sector provides the bulk of seed planted by farmers in developing countries (Bishaw, 2004). It operates at the farm level and depends on local knowledge of plant or seed selection and management practices. It does not involve seed certification procedures and although the role of the informal sector is recognized, few attempts have been made to assess the status of seed quality. Seed from the formal sector must meet specific quality standards prescribed by the national regulations and involve certification agency which establishes technical, administrative and regulatory frameworks to produce quality seed that meets specified minimum standards for marketing. Apart from good crop management practices to maintain varietal purity, laboratory tests are conducted to assess critical seed quality attributes. Seeds carry genetic potential of plants and influence the productivity of other agricultural inputs. Availability of, access to and use of quality seeds are determinant of the efficiency and productivity of other technologies in increasing crop productivity.

Soybean (*Glycine max*) is an important multipurpose crop utilized for food, livestock feed, industrial raw material and bio-energy (Myaka *et al*., 2005). It is also the world leading source of oil and protein (Fedaku *et al*., 2009) with 20% oil content, 40% protein and 35% of carbohydrates and is cholesterol free with low levels of saturated fatty acids. The biomass from soybean is an important source of animal feed, green manure and can also be used as mulch (Chianu *et al*., 2009). In Kenya soybean is being promoted as a cultural source of protein, cooking oil, income to farmers and for soil fertility improvement (Misiko *et al*., 2008). Sanginga *et al.* (2003) estimated that soybean can fix 44-103 kg/ha of nitrogen reducing the need for expensive nitrogen fertilizers. It adds nitrogen to the soil enriching infertile soils and stimulating crops productions in rotation especially with cereals (Ojiem, 2006).

Western region is the leading soybean production area in Kenya accounting for

80% of the total national soybean production with the main production areas being Butere/Mumias, Bungoma, Busia, Teso, Kakamega, Mt. Elgon, Lugari and Vihiga (Chianu *et al*., 2008). However, production is still below their maximum potential due to some challenges facing the farmers. Lack of adequate and quality seed supply by the formal system and lack of knowledge on production and post-harvest practices of soybeans also hindered farmers from accessing improved quality seeds (Oshone *et al*., 2014). This has led to about 70% of the farmers recycling seeds from informal sources and because seeds from such sources are of poor quality they result in poor yields. A baseline survey conducted by Odendo *et al*. (2008) revealed that communities in this region had interest in growing soybeans but had no access to improved varieties, good quality seeds and resorted to using seeds obtained from informal sources to raise crops in the following season. This study therefore aimed at determining the effect of seed source, production and post-harvest handling on quality of soybean seeds in Busia County.

## Materials and Methods

A purposeful survey was conducted using a semi-structured questionnaire to collect information on source of soybean seeds, production and post-harvest handling practices. Seed samples were collected from farmers, local market and agro-dealers in Low Midland Zones I, II and IV. The seeds were evaluated for purity, seed coat damage, moisture content, germination, vigour and infection in the laboratory.

### Seed quality tests

### Determination of physical purity of soybean seeds

Analytical purity was conducted in accordance to ISTA 2015 guidelines. The different components comprising the sample were grouped into, pure seed, inert matter, other crop seeds and weed seed. Percentage of each component was calculated as a fraction of the initial weight as indicated below:

$$\text{Component (\%)} = \frac{\text{Weight of each component fraction X 100}}{\text{Initial weight of the sample}}$$

### Determination of moisture content and seed coat damage

Moisture content was determined using a moisture meter by filling the meter cup with soybean seeds and recording the readings. The test was repeated four times. Seed coat damage was detected by sodium hypochlorite test as per Van Utrecht *et al*. (2000). Four replicates of 100 seeds were soaked in 1% sodium hypochlorite solution for 10 minutes. Seeds were considered to be damaged when the seed coat appeared wrinkled, swollen or with loose coats. Damaged seeds were counted and the percentage estimate of seed coat damage of a sample calculated using the formula:

$$\textbf{Damage}(\%) = \frac{(\text{No. of swollen seeds after test})\ \text{x}100}{\text{Total number of seeds used}}$$

**Determination of germination and seedling vigour of soybean**

Germination test was done according to ISTA 2015 guidelines on paper towel to determine the percentage of viable seeds in a sample. Seeds were surface sterilized in 2% sodium hypochlorite solution for five minutes to kill epiphytes followed by three changes of sterile distilled water. Four replications of 100 seeds each in transparent plastic boxes lined with absorbent towel. The boxes were arranged in a completely randomized design (CRD) in the laboratory under room temperature conditions. The seed were routinely misted with sterile distilled water. Seeds were considered germinated when 2mm of the radicals protruded and germination percentage calculated as shown below (Chirchir *et al.,* 2016).

$$\textbf{Germination}\ (\%) = \frac{(\text{Number of germinated seeds})\ \text{x}100}{\text{Total number of seeds}}$$

Germination rate index was also calculated as shown below:

$$\textbf{GRI} = \frac{\text{No. germ. seeds 1st}}{\text{Days of 1st count}} + \frac{\text{Germinated final count}}{\text{Days of final count}}$$

Seedling vigor was determined after 15 days by randomly selecting 10 seedlings from each replicate and measuring the root and shoot lengths using a ruler in centimeters. These were then used to calculate the seedling vigor index (SVI) using the formula described by Aliloo and Darabinejad, (2013).

$$\textbf{SVI} = \frac{\text{Germination \% x Seedling length}}{100}$$

**Determination of fungal infection in soybean seeds using agar plate method**

Soybean seeds were surface sterilized in 2% sodium hypochlorite for three minutes, followed by rinsing in three changes of sterile distilled water and blot dried on sterile paper towel. Four replications of 10 seeds per petri dish were plated on Petri dish containing potato dextrose agar media and incubated for 3-7 days at $25^{0}$c in alternating dark and light conditions (Alemu, 2014). Sodium chloride was added to the media to inhibit germination and streptomycin sulphate to inhibit bacterial growth. The number of seeds infected and the individual pathogen types were recorded and results expressed as a percentage. Fungi growing on potato dextrose agar plates were identified both visually and under the stereomicroscope by observing colony characters and morphology of sporulating fungi (Shovan *et al*., 2008).

**Data analysis**

Survey data was analyzed using IBM Statistical Package for Social Science (SPSS) version 20. Laboratory tests data were subjected to analysis of variance (ANOVA) using GENSTAT $15^{th}$ edition. Means were separated using Fischer's protected Least Significant Difference (LSD) at 5% level of significance (Steel and Torrie, 1960).

## Results

### Source of soybean seeds and post-harvest practices used by farmers in Busia County

Most (48%) of the farmers used farm saved seeds, 29% and 23% were using seeds obtained from community based organizations and local markets respectively, across the three zones. Over (60%) of farmers in LM II used own saved seeds as compared to other zones while around 45 % sourced from community based organizations within their locality (Table 1).

Table 1: Percentage of farmers who obtained soybean seeds from different sources in three agro-ecological zones in Busia County.

| n=60 | Agro-Ecological Zones | | | |
|---|---|---|---|---|
| Source of seed | LM I (%) | LM II (%) | LM IV (%) | Mean |
| Farm saved | 40±8.3 | 65±8.3 | 40±8.3 | 48.3±7.6 |
| Local market | 30±4.4 | 25±4.4 | 15±4.4 | 23.3±7.6 |
| Community based organizations | 30±10.1 | 10±10.1 | 45±10.1 | 28.3±7.6 |

N=Sample size, LM I= Lower Midland Zone I, LM II= Lower Midland Zone II, LM IV = Lower Midland Zone IV

About 92% of farmers threshed soybean crop by beating with sticks, 5% used their hands to remove seeds from the pods while 3% put soybean in a sack and beat them with sticks. All the farmers in LM I threshed soybean using sticks. Threshing inside the sack with sticks attracted only 5% of the farmers in LM II and IV. Hand threshing was practiced by 15% of the farmers in LM IV (Table 2).

Table 2: Percent farmers using different techniques to thresh soybean in three agro-ecological zones in Busia County.

| **n=60** | **Agro-Ecological Zones** | | | |
|---|---|---|---|---|
| **Threshing method** | **LM I (%)** | **LM II (%)** | **LM IV (%)** | **Mean** |
| Removing seeds from the pods by hand | 0±5.0 | 0±5.0 | 15±5.0 | 5.0±29.2 |
| Beating with stick on the floor | 100±6.0 | 95±6.0 | 80±6.0 | 91.7±29.2 |
| Beating pods in a sack with sticks | 0±1.7 | 5±1.7 | 5±1.7 | 3.3±29.2 |

N=Sample size, LM I= Lower Midland Zone I, LM II= Lower Midland Zone II, LM IV = Lower Midland Zone IV

About 67% of the farmers in Busia County did not treat soybean seeds. Around 60% of the farmers in LM I adopted seed treatment technology practice. In LM II and IV more than 70% of farmers did not treat the seeds either before storage or planting (Figure 1).

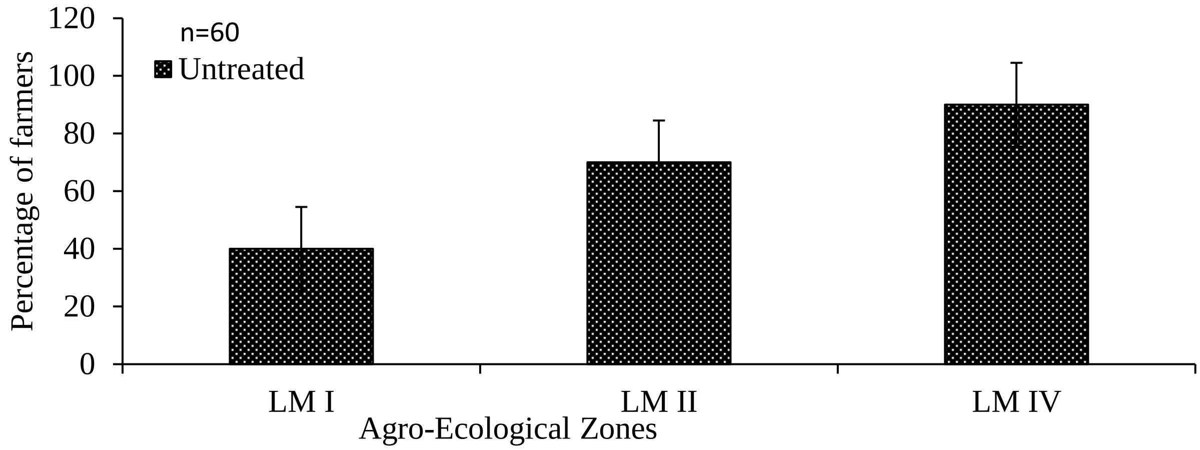


Figure 1: Percentage of farmers who did not treat soybean seeds before storage or planting in three zones Busia County.

Farmers stored soybean seeds up to a period of twelve months. However, majority (68%) reported to have stored seeds for three months. Only 5% as the smallest group stored their seeds for one year. Around 8% stored for one month, 7% stored for two months and about 12% of farmers stored for six months which was equivalent to two growing season. Farmers stored seeds for only two to six months period in LM II. While in zone IV seeds were stored for twelve months (Table 3)

Table 3: Percentage of farmers who reported the duration of storage of soybean seeds in three agro-ecological zones in Busia County.

| n=60 | Agro-Ecological Zones | | | |
|---|---|---|---|---|
| Duration of storage | LM I (%) | LM II (%) | LM IV (%) | Mean |
| Up to 1 month | 10±4.4 | 0±4.4 | 15±4.4 | 8.3±12.1 |
| 1 to 2 months | 5±1.7 | 10±1.7 | 5±1.7 | 6.7±12.1 |
| 2 to 3 months | 75±9.3 | 80±9.3 | 50±9.3 | 68.3±12.1 |
| 3 to 6 months | 10±1.7 | 10±1.7 | 15±1.7 | 11.7±12.1 |
| Over 12 months | 0±5.0 | 0±5.0 | 15±5.0 | 5.0±12.1 |

N=Sample size, LM I= Lower Midland Zone I, LM II= Lower Midland Zone II, LM IV = Lower Midland Zone IV

**Quality status of soybean seeds used in Busia County**

The analytical purity components of the seed samples from different sources differed significantly. Seeds obtained from agro-dealers had the highest percentage of pure seed followed by own saved seeds and lastly by seeds from the local market. However, all the seeds from the three sources did not meet the recommended physical purity standard of 98% (Table 4). The analysis indicated that seeds from the informal sources had damaged seed coats of 88% as compared to seed from agro-dealer (82%).

Table 4: Analytical purity of soybean seed samples from various sources in different agro-ecological zones in Busia County.

| | **Components** | | |
|---|---|---|---|
| **Source** | **Pure seed** | **Other crop seed** | **Inert matter** |
| Agro-dealer | 97.2a | 0.2b | 0.1c |
| Farm-saved | 92.5bc | 0.3a | 1.0a |
| Market | 91.1c | 0.4a | 0.6b |
| Mean | 93.6 | 0.3 | 0.6 |
| LSD($P \leq 0.05$) | 2.1 | 0.1 | 0.3 |
| CV | 5.0 | 118.8 | 120.8 |

LSD=least significance difference, CV=coefficient of variation.

Moisture content of seeds from the three sources did not differ significantly. Comparable results were recorded on damage caused by insects in seeds collected from the informal outlets and high compared to seed from formal source (Table 5).

Table 5: Percent moisture content, seed coat damage and insect damage of soybean seed samples collected from different sources in the three agro-ecological zones in Busia County.

| **Source** | **Moisture content** | **Seed coat damage** | **Insect damage** |
|---|---|---|---|
| Agro-dealer | 9.1a | 81.8b | 0.5b |
| Farm-saved | 9.1a | 88.4a | 1.6a |
| Market | 9.2a | 87.7a | 1.6a |
| Mean | 9.1 | 86.0 | 1.2 |
| LSD($P \leq 0.05$) | 0.3 | 3.0 | 0.3 |
| CV | 7.5 | 8.0 | 83.2 |

LSD=least significance difference, CV=coefficient of variation

Germination percentage of soybean seeds from different sources differed significantly. Germination percentage of the seeds from the three sources met the minimum germination standard recommended for soybean seeds of 75%. Agro-dealer seeds recorded the highest germination percentage of 90% followed by local market (76%) and farm saved seeds (75%) respectively. High germination rate, number of normal seedlings and seedling vigour index was also observed on seeds from this source (Table 6).

Table 6: Percent germination and seedling vigour of soybean seed samples from different sources in three agro-ecological zones in Busia County.

| | Germination | | Seedlings | | |
|---|---|---|---|---|---|
| **Source** | **Germination%** | **Germination rate** | **Normal** | **Seedling Length** | **Seedling vigour index** |
| Agro-dealer | 90.0a | 30.6a | 82.5a | 8.4a | 7.6a |
| Farm-saved | 75.2b | 23.3b | 69.0b | 5.5c | 4.8c |
| Market | 75.9b | 23.3b | 66.5b | 6.8b | 5.7b |
| Mean | 80.4 | 25.7 | 72.7 | 6.9 | 6.0 |
| LSD($P \leq 0.05$) | 7.7 | 3.4 | 7.6 | 1.4 | 1.4 |
| CV | 21.8 | 30.1 | 23.8 | 45.7 | 52.1 |

LSD=least significance difference, CV=coefficient of variation.

Infection of seeds collected from different sources and zones differed significantly. High number of seed infection was observed on seeds obtained from farmers and local markets. Infection by *Cercospora kikuchii and Penicillium spp.* were observed on seeds collected from local market. *Aspergillus falvus and Aspergillus niger* were the most prevalent in seed obtained from the farmers. Seeds collected from the agro-dealer outlets had the least incidence of fungi observed (Table 7).

Table 7: Percentage of fungi in soybean seed samples from various sources in different agro-ecological zones in Busia County.

| | Fungi | | | | |
|---|---|---|---|---|---|
| **Source** | **Infected** | ***C. kikuchii*** | ***A. flavus*** | ***A. niger*** | ***Penicillium spp.*** |
| Agro-dealer | 10.0b | 0.0b | 0.0c | 0.0b | 0.0b |
| Farm-saved | 28.6a | 1.1ab | 7.8a | 5.2a | 2.3a |
| Market | 23.2a | 2.2a | 3.8b | 2.0b | 2.8a |
| Mean | 20.6 | 1.1 | 3.9 | 2.4 | 1.7 |
| LSD($P \leq 0.05$) | 9.6 | 2.2 | 4.7 | 4.7 | 2.8 |

LSD=least significance difference, C-Cercospora, A-Aspergillus, spp.-species.

## Discussion

Most of the farmers in Busia County utilized soybean seeds from the informal sources with majority of them using farm saved seeds usually obtained from the previous season. Most of the farmers have opted to save seeds to replant in the following season due to financial constraints, inadequate seeds of good quality and high cost of certified seeds. Informal seed sources readily availed the seed to farmers every season since most of them save up for the next planting. Findings reported by Oshone *et al*. (2014) similarly indicated that majority of the farmers in Ethiopia obtained common bean seed from informal sources a channel which contributed more than 95% of the common bean seed supply in Ethiopia. Similarly, Chianu *et al*. (2009) conducted a survey on soybeans in Kenya and revealed that most farmers used saved seeds or seeds sourced from the open air markets which at times were of mixed varieties to raise crops the following season due to their availability.

The formal seed source supplied inadequate seed and this was further confirmed with similar findings by Anon (2001) which revealed that the formal sector supplied only 4% of seeds sown by farmers and the remaining 96% was supplied by the informal sources in most African countries. Similarly, Adetumbi *et al.* (2011) reported that 100% of the seed industries which is a representation of formal sector handled maize, 82% for cowpea and 82% vegetables compared to 27% for soybean seeds. A baseline survey conducted by Odendo *et al*. (2008) revealed that most farmers in Western region of Kenya had interest in growing soybean but had a challenge in accessing improved varieties and good quality seed during planting. In addition, lack of adequate and quality seed supply by the formal system hindered farmers from accessing improved quality seeds (Oshone *et al*., 2014). The few seed industries in Kenya do not produce adequate seeds of soybean to meet the demand and most of them have given priority to cereals or high value crops for them to make profits (Lowaars *et al*., 2012).

Majority of the farmers interviewed reported to thresh soybean with sticks and as a result farmers experienced a challenge of reduced germination and vigor in soybeans. The results were in agreement with the findings by Surve *et al*. (2015) who reported that hand threshing practices usually used by few farmers of soybean recorded minimal seed coat damage and high germination compared to other techniques practiced by farmers such as stick beating and mechanical threshing. Similarly, Jha *et al*. (1995) found that hand threshing resulted in higher germination and less deterioration of seed than the other techniques. Hand threshing of soybean significantly increased seed yield compared with stick threshing and mechanical threshing (El-Abady *et al*., 2012). Threshing techniques like machine and stick beating produces more breaks, cracks, bruises and abrasions which results in reduced germination and vigor and increase in abnormal seedlings (Reddy *et al*., 1995).

Survey findings indicated that majority of the farmers do not treat seed during planting or before storage. Untreated seeds act as vehicles of transmitting pathogens which cause diseases in soybean seeds. These pathogens affect germination and seedling vigor and as a result lower emergence and productivity (Sinclair, 1991). Treatment provide additional assurance to crop establishment at reduced cost and allows germination of infected seeds by controlling pathogens and protecting seed from fungi (Araujo *et al*., 2005)

The survey revealed that most of the respondents stored their seeds for a maximum period of three months and the second best storage period being six months. Between 0 and 2 months was the period between harvest and the next season of planting hence few farmers reported this storage period. The period also could be after-ripening session of soybean for it to mature fully thus minimal deterioration. The observed reduction in percentage germination and vigor over time could be linked to depletion of reserved food for the embryo. This is in line with the findings of Iqbal *et al*. (2002) and

Demirkaya *et al*. 2010) that reduction of viability and vigor could be attributed to a reduction in enzyme activity within the seed. In addition, the reduction in seed quality with time could be as a result of membrane degradation (Singh and Dadlani, 2003), reduction in enzyme activity or changes in chemical composition of the cell (Verma *et al*., 2003). Similarly, Younesi and Azadi (2013) reported that an increase in duration of storage caused a decrease in the enzyme activity of sorghum seeds.

Other studies have shown a gradual decrease in germination and vigor of soybean cultivars with increasing period of storage up to six months (El-Abady *et al*., 2012) and extending storage period intensified deterioration hence low productivity of soybean (Adoba *et al*., 2016). Belesevic *et al.* (2010) found that storage conditions and durations affected germination but adversely affected seed vigor. According to Arif *et al.* (2006) seed viability decreased gradually from 64.5% to 39.2% as duration of storage increased from 2 months to 12 months. Similarly, Sadia *et al*. (2016) found that germination and seed vigor of cowpeas declined with increase in storage duration irrespective of genotypes or storage materials. In addition, more decline in germination of soybean stored under conventional condition due to variable temperature and humidity was also reported by Balesevic-Tubic *et al.* (2010). If the seeds are not dried properly high moisture content reduces seed viability by promoting fungal growth (Pradhan and Badola, 2012) which further results in reduction of germination. For oil crops such as soybeans and sunflower, increased content of fatty acid and auto oxidation of lipids during storage are the main causes of rapid deterioration of oil crops seeds (Balasevic-Tubic *et al*., 2005).

Analytical purity of seeds from different sources varied significantly but did not meet the minimum recommended purity standard of 98%. Seeds collected from agro-dealers were more pure as compared to seed from local market and farmers. Similar observations were made by Rahman *et al*. (2017) that okra seeds obtained from seed companies were more pure followed by those from government organizations and then the farmer's seeds. Bishaw *et al*. (2012) working on barley also observed that seeds obtained from the formal sector had the highest analytical purity as compared to those collected from the farmers and local markets. Fujisaka *et al.* (1993) found that rice seeds samples that were obtained from farmers who used manual harvesting and threshing had higher analytical purity compared with those that were machine harvested. The use of non-cemented floors during threshing in the rural setting resulted in accumulation of foreign materials in farm saved seeds. Sarker *et al*. (2015) on quality of okra seeds from different sources and locations cited lack of careful attention during cleaning operations contributed to high percentage of reduced purity in farm saved seeds.

The present findings indicated that seeds obtained from the informal sources recorded higher percentage of damaged seeds compared to seeds from the formal sector. The extensive damage of seeds from the informal sector is due to poor handling and post-harvest techniques which in turn reduced seed quality. Similar findings were reported by Reddy *et al*. (1995) that seed damage occurred during threshing in soybean and resulted in shorter storage life of seeds. Costa *et al*. (2005) studies on zoning soybean crop found out that the spoilage caused by physical injury and moisture content were the main factors that contributed to reduced quality of soybean seeds. Similarly, mechanical damage was considered the most common reason for poor quality in most legumes especially when threshed at unsuitable seed moisture content (Greven *et al*., 2001). Pacheco *et al*. (2015) pointed out that physiological quality, vigor and performance of soybean seeds was highly influenced by seed coat injury. Soybean seeds obtained from informal sources had more physical injuries because the farmers had poor knowledge on how to handle them soybean seeds which have a sensitive seed coat. Minimal injuries on seeds obtained from the formal sources may be attributed to improved and planned processing technology and knowledge of handling soybean (Araujo *et al*., 2008). Cracks on the seeds may also become entry points of microorganisms and become susceptible to insect attack which reduces the storage potential and the general quality of the seeds (Marcos Filho, 2005).

Percentage germination in seeds from the agro-dealer a formal sector was higher as compared to those from the informal sources. The high quality of seeds from the formal sector may be due to the fact that they have equipment and knowledge of handling seeds. According to Adetumbi *et al.* (2010), the formal sector is well equipped with sophisticated equipments and skills of handling seeds to ensure that the quality of seed is maintained all through. One major quality control mechanism that has been instituted in the formal seed sector is regular seed inspection at different levels from seed field to distribution channels. This has ensured that the quality of the seed is maintained from the field all the way to the hands of the final consumer, the farmer. Bishaw *et al*. (2012) also reported that percentage germination of certified seed from the formal sector was higher compared with seed obtained from other farmers, local markets and own saved seeds. Al-Faqeeh (1997) in his studies also found that certified seed had significantly higher germination in Lentils compared with seeds from other sources. Germination percentage of seeds from farmers was comparable to the minimum standard. This can be attributed to the fact that most farmers do selection of quality seeds for planting though using informal procedures which may vary from farmer to farmer. Similar results were also reported in Ethiopia where almost all samples collected from the farmersreached the minimum germination standards for wheat (Ensermu *et al*., 1998) and sorghum (Mekbib, 2008).

Seeds obtained from the local market and own saved were more infected as compared those from the agro-dealers. This is due to lack of standard procedures and regulations govern production of pathogen free seeds.

*Cercospora kikuchii*, *Penicillium spp*., *Aspergillus niger and* flavus (Bhale *et al*., 2004) were recorded as the most common fungal pathogens that infected soybean in Busia County. Most pathogens that are seed-borne are difficult to detect by most farmers and may assume that seeds are healthy while they are not in reality. Our findings relate with those of Bhale *et al*. (2004); Wu *et al*. (1964) who isolated *Fusarium oxysporum*, *Aspergillus niger* and *Aspergillus flavus, Cercospora kikuchii, Penicillium sp., Phoma medicaginis, Macrophomina phaseolina Alternaria alternate* as seed-borne pathogens which are most predominant fungi in pre and post harvested soybean seeds. Presence of these fungal pathogens reduces physiological potential of soybean seeds (Galli *et al*., 2007). Singh and Agrawal (1986) reported 30% loss in seed viability and germination because of purple stain caused by *Cercospora kikuchii,* while, *Aspergillus flavus*, *Aspergillus niger*, *Fusarium spp* were responsible for seed rots and post emergence decays (Koning *et al*., 1995).

Seeds from the formal source registered low infection as compared to seed from the informal sector due to unhygienic storage conditions at the farmer's level (Utoba *et al*., 2011). Variation in fungal incidence was attributed to variations in climatic conditions during the crop cycle especially the prevailing humidity which favor the growth of the pathogens (Naqvi *et al*., 2013). The formal sector also practices seed treatment using fungicide, insecticides or combination of different chemicals which protect the seed from infections. Seed dressing protects the growing seedling for a specific period helping it escape infection (Ellis *et al*., 2011). This technique has shown significant improvement in field emergence, seed yield and reduced mycoflora association (Anuja *et al*., 2000).

**Conclusion**

Majority of farmers from the different agro-ecological zones in Busia obtained seeds for the following season from informal seed sources. These seeds were found to be of poor quality having low germination and vigor, high infection incidence and physical quality that is below the ISTA recommended standard of 98%. Most of the farmers also did not treat soybean seeds and had limited knowledge on post-harvest handling and sensitivity of soybeans.

## Recommendations

More training on appropriate post-harvest technologies is recommended in order to ensure high quality seeds. The use of fungicides, insecticides or combination of different chemicals which protect the seed from infections are also encouraged. Farmers should use seeds from the formal sector which are certified and of known good quality. In addition, extensive training should be done on the appropriate post-harvest handling techniques and sensitivity of soybean seeds.

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