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Cowpea (*Vigna unguiculata*) Pest Control Methods in Storage and Recommended Practices for Efficiency: A Review

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Abstract

Cowpea storage is a profitable venture in Nigeria for the purpose of maintaining regular supply throughout the year and price stabilization when Government buys surplus cowpea at time of harvest at low prices and release them periodically in times of scarcity to force prices down and prevent inflation. In spite of these advantages, storage of cowpea has always been limited by pests and diseases leading to their deterioration. Insect pests are the most constrain in cowpea storage and also fungal diseases growing on or in stored cowpea causing a variety of losses, which includes decrease in germinability, discoloration, heating and mustiness, and change in taste. Therefore, for efficient storage of cowpea, control measures must be adopted through the use of good storage structures, use of conventional chemicals, and use of plant materials. Also recommended practices for cowpea storage must be adhere to and also proper storage would reduce losses and guarantee near even prices for the commodity throughout the year in various parts of Nigeria.

Keywords: Cowpea, Pest Control Method, Storage

1. Introduction

Cowpea, *Vigna unguiculata* (L.) Walp (Family: Leguminosae) is grown and consumed for its high protein content (23-25%). The crop grows well in the Guinea and Sudan Savannahs of Nigeria. Nigeria is the largest producer of cowpea in the world. Pests and diseases are the most important impediment to cowpea production. In storage, cowpea is also affected by pests and diseases leading to their deterioration, and loss of nutritive value.

The diseases found on cowpea are mainly fungi while the other pests are insects and rodents. Insects are by far the most important limiting factor in the efficient storage of cowpea. Losses of up to 30-70% have been recorded on stored cowpea in the absence of insect pest control measures. (Anonymous, 1996).

Cowpea storage may be conducted for the purpose of; Maintaining regular supply throughout the year, Sale in times of scarcity at high prices to fetch more money, Preservation of seeds for planting at the next cropping seasons and it also encourages Price stabilization when Governments buys surplus cowpea at time of harvest at low prices and release them periodically in times of scarcity to force prices down and prevent inflation.

The various storage methods adopted by farmers depend on the purpose of storage and the quantity of cowpea produced or procured for storage. The main thrust of this paper is to highlight some of the control methods and practices recommended for efficient cowpea storage.

2 Pests and Diseases of Stored Cowpea

The major insect pests of stored cowpea in tropical Africa include:

Callosobruchus maculatus (Fab.) and ii) *Bruchidius atrolineatus* (Pic), with the former the most prevalent. *C. maculatus* attack usually starts with females laying eggs on ripening cowpea pods in the field (Caswell, 1976). In northern Nigeria, less than 5% of pods are infested (Booker, 1967). During eclosion, the larvae burrow through the chorion of the egg directly into the pod wall, and then into the seed, where the larvae develop and pupate (Messina, 1984). Store infestation is frequently derived from harvested field-infested pods or seeds (Alzouma, 1981) but may also come from hidden infestation in the store respective of source of initial infestation, the founder population consists of relatively few individuals that can breed and proliferate to pest proportions in a relatively short time (Messina, 1989).

Bruchidius atrolineatus (Pic). This beetle commonly infests and damage seeds of cowpea (*V. unguiculata*) and is sympatric in the distribution with C. maculatus in the West African Sahel (Ofuya and Credland, 1995b). B. atrolineatus is primarily a field pest (Booker, 1967). In the West African Sahel, adults are seen in cowpea fields at the flowering and podding phases and the females lay eggs on mature and ripening pods, and at harvest about 80-90% of the pods are infested (Alabeek, 1996). Average egg loads in the field are about ten eggs per pod, but may be higher (Huignard et al., 1985). Cowpea pods taken into storage are infested with *B. atrolineatus* eggs and the larvae at different stages of development.

2.1 Fungal diseases on stored cowpea

These are caused by *Aspergillus flavus* and *Aspergillus fumigatus*. The fungi associated with stored foods and agricultural commodities have been classified into two types namely, the field and storage fungi (Christense, 1957). Most of the storage fungi are moulds. Although, grains naturally acquire a mould flora in the field and after harvest, they are normally of little consequence unless the environmental conditions favour fungal growth. Thus, poor storage conditions predispose grains to fungal spoilage, this being exacerbated by insect damage. Climatic conditions in the tropical countries often provide ideal conditions for high mould growth which develop on or within seeds at moisture contents within the storage structure.

2.2 Effect of fungi on stored cowpea

Fungi growing on or in stored cowpea cause a variety of losses. These include ; decrease in germinability; discoloration of parts (usually the germ or embryo) or all the seed; heating and mustiness; various biochemical changes such as increase in fatty acids, reducing sugar and respiration; production of mycotoxins which if consumed may be harmful to man and animals; and loss in weight (Bunyam, 1987). The fungi decrease the quality of the cowpea through discoloration or change in taste (bad flavor or smell) and also decrease the nutritive value. Spontaneous heating and associated increase in respiration of the grain in storage has been reported to be due to microorganisms and are known to raise the temperature of the grain up to 70-75^{o}c (Kasperssen, 1986). The effect on seed germinability has been linked to the invasion of the embryo by storage fungi. These authors reported the invasion of germ of seeds by species of *Aspergillus* which led to the rapid death of the germ (Christense and Kaufmann, 1996).

2.3 Control of Cowpea Storage Pests

The control of cowpea storage pests and diseases can be achieved by:

- Use of good storage structures
- Use of conventional insecticides
- Use of plant material

- Drying

2.4 Cowpea storage structures:

The following structures are recommended for cowpea storage:

- Earthenwave Granaries (Rumbus)
- Steel Drums/Tins
- Polythene bags
- Silos
- Pit method

Earthenwave

These are adapted for the storage of unthreshed cowpea. There are two types of rumbus

i. Grass rumbus

ii. Mud rumbus

Grass rumbus

The grass rumbus is usually a temporary storage structure often used where mud is scarce. The structure is cheap and easy to build and permits rapid drying of stored cowpea. Its use is however restricted to areas with low rainfall.

Mud rumbus

The mud rumbus is built from clay used with straw to strengthen it. It is rounded or oval in shape and usually supported at the base with large stones.

The wall of the rumbus should be smooth with no cracks or crevices where insects can take refuge. Rumbus may require periodic application of insecticide as they are not completely air-tight. The capacity ranges from 1.0-5.0 metric tonnes of grains.

Steel drums/Tins

Cowpea storage in steel drums and tins is a form of hermetic storage where the storage structures are air-tight. Since air (oxygen) is essential for the development and multiplication of stored produce insect pests, the air-tight container deprives the pests of air leading to their death by asphyxiation. The use of steel drums/tins is suitable for storage of threshed cowpea. The method is not hazardous since no chemical treatment is required.

Polythene bags

This is another form of hermetic storage, with the polythene bags designed to be air-tight. They are suitable for the storage of threshed cowpea over a long period.

The use of baft cotton liner enhances the air-tightness. The method like other hermetic storage structures may require no chemicals.

Silos

Butyl rubbers or aluminium silos may be used. These are suitable for large scale storage of threshed cowpea and are recommended mainly for companies, ministries and co-operatives. Cowpea stored in silos may be fumigated every three months starting from two or three weeks of storage.

Pit Method

Cowpea can be stored in pits usually measuring 4x4x2 m. The floor of the pit is cemented to prevent moisture from entering the pit. This method is suitable for storage of threshed cowpea but is however restricted to areas with low annual rainfall. The pit is normally covered with polythene sheet or mat and then covered with soil.

The major problem with this device is usually in the wall lining, which may be eaten up by termite, and the structure is not rodent proof. Maintenance is usually done by cleaning and replacement of the wall lining. Maintenance cost is dependent on the locality and availability of material (Adejumo and Raji, 2007), but it is generally affordable to the rural poor farmers. This is commonly found in Borno and Yobe states where the water table is low.

2.5 Use of conventional insecticides

Where grains are already infested by insect pests, it often becomes necessary to apply insecticides for their control. The recommended insecticides for storage of cowpea in Nigeria include:

- Actellic 25 E.C
- Actellic 2% dust
- Phostoxin tablet

Actellic 25 EC

The application of Actellic 25 E.C to cowpea is recommended where there is bulk storage over a long period. Application of Actellic 25 E.C should be at 10-20 ml in 1-2 litres of water per 100 kg cowpea using a suitable nozzle as the grain is fed into the store. It is essential to cover the store as the fumigant action of Actellic will help in the control of insects in the store by making the store air-tight for the gas to penetrate and remain in the commodity for long enough to kill all stages of the insects present in or amongst the grains.

Actellic 2% dust

Apply 25-50 g dust to a layer of 50-100 kg of unthreshed cowpea. Application of Actellic dust on threshed cowpea has to be at about 10-12 ppm rate which is the FAO recommendation. Dusts usually work at higher dosage to control cowpea bruchids but make the grains unsafe for human consumption. The application should be repeated after 2-3 months of initial treatment.

Phostoxin (Aluminium phosphide)

This should be applied at the rate of 1 tablet per 100 kg cowpea in an air-tight container. Place the tablet in a paper envelops or wrap securely in tissue paper. After four days, remove and bury the paper and its contents. Phostoxin tablets may be used at the rate of 1-3 tablets per ton. The treatment should be repeated after 4-6 months.

Precautions

- The fumigated grains should be maintained in insect proof containers to prevent re-infestation.
- All fumigants must be handle with care because of the hazards to man if inhaled.
- Application should be away from living houses and domestic animals.

2.6 Use of plant Materials

Several plant materials have been found to be effective in controlling insect pests of stored cowpea. Neem kernel powder applied at 5-10 g per 100 g seed has been found to be effective in protecting

stored cowpea from insect attack (Sowunmi and Akinnusi, 1983; and Ivbijaro M.F. (1983); Oparaeke et al., 1998).

Similarly powders of Eucalyptus, guava, and lemon grass leaves as well as orange and grape peels applied at similar rates can adequately control the insect pests on stored produce. *Sesamum indicum*, *Capsicum frutescens* (L.) *Ocimum basilicum* and ash have been used by farmers to control stored cowpea insect pests.

Groundnut oil at 5-10 ml per kg, palm oil, palm kernel oil and castor oil at 6 ml per kg cowpea seed have also been used to contain insect pests of stored cowpea.

Most plant materials have repellant, anti-feedant and insecticidal properties. Some also interfere with normal activities of the pests preventing their multiplication. The plant materials are cheap, easily available and easy to use. They have low mammalian toxicity, are non persistent and most do not affect seed viability and palatability.

2.7 Drying

Excessive moisture content levels lead to deterioration of cowpea and make them more susceptible to infestation by insect pests and infection by fungi. At harvest, cowpea should be left to dry for some time to reduce the moisture content to safe levels. The safe moisture content level for cowpea is 13% or lower.

3. RECOMMENDED PRACTICES FOR COWPEA STORAGE

- Cowpea should be harvested promptly as soon as they mature to avoid infestation on the field.
- Cowpea should be dried properly to moisture contents below 13%. Properly dried grains are less easily attacked by insects and fungi.
- Stored cowpea should not be kept on the bare floor to avoid migration of moisture to the cowpea.
- Cowpea for storage should be healthy, not broken or damaged as this encourages insect infestation.
- Storage of cowpea may be done in rumbus, steel drums/tins, polythene bags or silos. The storage structures should be air-tight to starve the insect of oxygen.
- Rumbus should be properly cleaned before use for storage.
- Cracks on the walls, roof and floor of rumbus should be mended to deny insects of hiding places.
- Infested grains should be fumigated with phostoxin or any other fumigant. Actellic E.C or Nuvan E.C could also be sprayed on cowpea at manufacturer recommended rate.
- Stored cowpea should be inspected frequently to enable early detection of infestation.
- Stores should be some reasonable distance from the field to discourage re-infestation.

4. CONCLUSION

Storage therefore occupies a vital place in the economies of developed and developing countries alike. Since Nigeria is a major cowpea producer and cost of protein/ kg is expensive, cowpea remains the greatest supplier of protein in the diets of Nigerians.

The main function of storage is to even out fluctuations in market supply, both from one season to the next and from one year to the next, by taking produce off the market in surplus seasons, and releasing it back onto the market in lean seasons, this in turn check out fluctuations in market prices. The desire to stabilize prices of basic foods is one of the major reasons why Government should try to influence the amount of storage occurring, and often undertake storage themselves.

REFERENCES

Adejumo, B. A. & Raji, A. O. (2007), Technical Appraisal of Grain Storage System in The Nigerian Sudan Savanna. Agricultural Engineering International: *The e-Journal Invited Overview 11*. Vol. IX September, 2007.

Alebeek, F. A. N. van (1996), Natural suppression of bruchid pests in stored cowpea (*V. unguiculata* (L.) Walp) in West Africa. *International Journal of pest Management* 42: 55-60.

Alzouma, I. (1981), Observations on the ecology of *Bruchidius atrolineatus* Pic. And *Callosobruchus maculatus* (F.) in Niger. In: V. Labeyrie (Editor). *The Ecology of Bruchids Attacking Legumes*, Junk, The Hague, pp. 205-213.

Anonymous, (1996). Lecture presented at PEDUNE Ecological Sustainable Cowpea pest Management Training Workshop held at IITA/IAR Research Station, Kano 27th May to 1st June, 1996. pp. 1-8.

Booker, R.H. (1967). Observation on three bruchids associated with cowpea in Northern Nigeria. *Journal of Stored Products Research* 3: 1-15.

Bunyam, P. J. (1987), Limiting the damage from storage pests and from their control: A Government's view. In Stored Products Pest Control. (T. J. Lawson Ed.).Monograph No. 37: 21-29.

Caswell, G. H. (1976), the storage of grains legumes. In: A. Youdeowei (ed.), Entomology and the Nigerian Economy. Entomological Society of Nigeria, pp. 131-142.

Christensen, C. M. (1957). Invasion of sorghum seed by storage fungi at moisture Contents of 13.5-15% and condition of samples from commercial bins. Mycopath. AppL. 44: 277-282.

Christensen, C.M. and Kaufmann, H. H. (1969). Grain Storage: The Role of fungi in Quality Loss. University of Minnesota Press, Minneapolis. 153 pp.

Huignard, J., Leroi, B., Alzouma, J. & Germain, J. F. (1985), Oviposition and Development of *Bruchidius atrolineatus* (Pic) and *Callosobruchus maculatus* (F.) (*Coleoptera: Bruchidae*) in *Vigna unguiculata* (Walp.) in Sahelian zone. Insect Science and its Application 6: 691-699.

Ivbijaro, M.F. (1983), Preservation of cowpea, *Vigna unguiculata* (L.) Walp with neem Seed, *Azadirachta indica* A. Juss. Protection Ecology 5: 177-182.

Kasperssen, A. (1986), The Role of fungi in the Deterioration of Stored Feed: Methodology and Ecology. Dissertation. Sveriges Lantbruksunversitet. Report 31. Uppsalaa 1986.

Messina, F.J. (1989), Genetic basis of variable oviposition behaviour in *Callosobruchus* maculatus (Coleoptera: Bruchidae). Annals of Entomological Society of America 82: 792-796.

Ofuya, T.I. & Credland, P. F. (1995b), Responses of three populations of the seed beetle, *callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) to seed Resistance in selected varieties of cowpea, *Vigna unguiculata* (L.) Walpers. Journal of Stored Products Research 31: 17-27.

Oparaeke, A. M., Dike M. C. & Onu I, (1998). Evaluation of seed and leaf powders of Neem, *Azadirachta indica* (A. Juss) and pirimiphos methyl for control of *C. maculatus* in stored cowpea seeds. Entomological Society of Nigeria Occasional Publication (Eds. N. E. S. Lale, N.B. Molta, P. O. Donli, M. C. Dike and M. Aminu-Kano) 31: 237-242.

Sowunmi, O. E. and Akinnusi, O. A. (1983). Studies on the use of the neem kernel in the Control of stored cowpea beetle (*Callosobruchus maculatus* (F.) Tropical Grain Legume Bulletin 27: 28-31.

Table 1: Common Storage Fungi and the Grains they Infect in Northern Nigeria.

Fungi	CP	So	Mi	Ri	Ma	Gn
Aspergillus flavus	+	+	+	+	+	+
Aspergillus fumigatus	+	+	+	+	+	+
Aspergillus niger	+	+	+	+	+	+
***Curvularia* spp**	+	+	+	+	+	+
Mucor pusillus	+	+	+	+	+	+
***Fusarium* spp**	+	+	+	-	+	+
***Penicillium* spp**	+	+	+	+	+	+
***Rhizopus* spp**	+	+	+	+	+	+
***Verticillium* spp**	-	+	+	-	-	-

CP = Cowpea; So = Sorghum; Mi = Millet; Ri = Rice; Ma = Maize; Gn = Groundnut

Sources: Ibrahim and Ebo (1988); Ndirmbita (1997): Umar (1998).