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ANALYSIS OF FARMERS' KNOWLEDGE LEVEL ON AFLATOXIN CONTAMINATION AND CONTROL IN CEREALS AND LEGUME CROPS IN JOS SOUTH LOCAL GOVERNMENT AREA, PLATEAU STATE, NIGERIA

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ABSTRACT

The survey analyzed farmers' knowledge level on aflatoxins contamination in cereals and legume crops in Jos South Local Government Area, Plateau State, Nigeria. Questionnaire was used to collect data from sample of one hundred and fourteen (114) respondents and was analyzed using a combination of analytical tools such as descriptive statistics (frequency, percentage, mean score) and correlation. Result revealed that majority (65.8%) of the respondents were females with an average age of 34 years, married (69.3%) and had a mean household size of 6 persons. About 84.2% had a form of formal education with major occupation being farming, cultivating an average of 3.3 hectares and had about 11 years of farming experience. Findings showed that 70% of the respondents knew what aflatoxins were, 63.2% knew that aflatoxins had serious health effects when consumed, about 65.8% knew that aflatoxins had effects on crops; however, result revealed that 25.4% of the respondents knew that aflatoxins contaminate food crops through poor and improper storage. About 22.8% knew that insect infestation leads to aflatoxins contamination, just 18.4% knew that contaminated seed can predispose food crops to aflatoxins contamination and about 13.2% of the respondents knew that aflatoxins contaminate food crops through the soil among others. Subsequently, the farmers adopted varying control measures to fight aflatoxins contamination which include: sorting of infected seeds (95.1%), use of certified seed (94.8%), timely and proper harvesting (88.7%), adequate and proper drying (88.7%), adequate storage system (87.5%), public awareness campaign (74.6%) among others. The study, thus, recommends creation of awareness by all concerned stakeholders on sources that lead to aflatoxin contamination of food grains and the risks associated with aflatoxins-contaminated food. Farmers and the general public should adhere strictly to the mentioned control measures of aflatoxin contamination on food grains in the study area.

Keywords: Farmers, Knowledge Level, Aflatoxin Contamination, Cereals, Legumes Crops

Introduction

Aflatoxins are naturally occurring mycotoxins found in cereals, dairy products, cocoa, grains, nuts, tea, spices and soil as well as animal and fish feeds (Hell *et al.,* 2010). They are naturally occurring toxins as a result of fungal metabolism and are produced by Aspergillus flavis and Aspergillus parasiticus which are the toxigenic characters of aflatoxins and are among the most harmful mycotoxins (CAST, 2003; Waliyar *et al.,* 2008). Mycotoxins are secondary fungal metabolites that contaminate agricultural produces and can cause sickness or death in humans and animals. United States Department of Agriculture (USDA) (2003); Hell *et al.* (2010*)* reported that mycotoxins infect about 25% of the world's food crops, of which the infamous are aflatoxins.

Aflatoxin is one of the most challenging mycotoxin because it could be produced by the responsible fungi at pre-harvest stage, post- harvest stages and at storage (Food and Agriculture Organization (FAO), 2004). They thrive in hot, dry climates of 30 to 40 degrees latitude with a high humidity of above 85% (Hell *et al.,* 2010) and their prevalence is intensified in suitable ecological conditions such as drought, pests, delayed harvest, insufficient drying and poor post-harvest handling (Williams *et al.,* 2004; Bankole *et al.,* 2006; Waliyar *et al.,* 2008). Aflatoxins possess economic and health importance because of their ability to infect both human food and animal feed (Severns *et al.,* 2003). Studies (Shephard, 2008; Bankole *et al.,* 2006; Wagacha and Muthomi, 2008) have shown that risk of mycotoxin contamination of food and feed in Africa is increased due to environmental, agronomic and socio-economic factors. Environmental conditions especially high humidity and temperature favour fungal proliferation. Farming practices in Africa sustain fungal and toxin contamination of food and feed (Hell *et al.,* 2010).

Report by Kumar *et al.* (2008); USDA (2003) revealed that a quarter of the world's food crops are estimated to be affected by mycotoxins; creating a large economic loss in the developed and developing countries. Findings of Williams *et al.* (2004) depicted that about 5 billion people in developing countries worldwide are at the risk of chronic aflatoxin exposure due to consumption of aflatoxin contaminated foods. Accordingly, Strosnider *et al.* (2006)*;* Shephard (2008) acknowledged that more than 4 billion people in the world had developed aflatoxin related health conditions. Although, James *et al.* (2007); Kumar & Popat (2010) revealed poor baseline knowledge of the toxin and its related health problems among farmers; Unnevehr & Grace (2020) affirmed that farmers and the general public in developing nations know less about aflatoxins and the associated health impacts.

The consumption of aflatoxin contaminated food by some people is because of low base knowledge about the adverse effect of aflatoxin on health. Kumar and Popat (2010) opined that about 74% of rural farmers interviewed in India had no knowledge of what aflatoxins were; still 55% believed that the presence of aflatoxin has no negative effect on the quality of food even when cooked. In another study Kiama *et al*. (2016) disclosed that farmers perceived eating moldy food as harmful but considered meat from animals fed moldy feeds to be safe. This endorses that consequence of Aflatoxin contamination of feeds is less known especially in the developing nations. With this proposition James *et al.* (2007); Jolly *et al.* (2009) recommended that it is central to awaken public consciousness on the toxin, uncovering its damaging impact on the crops, health risk associated with its consumption and proffer control measures that will help abate its prevalence while extending scientific findings to the wider public for tremendous natural and personal development

It has been perceived that creating awareness about aflatoxins by agricultural, research and medical professionals who have adequate knowledge about the toxin to the audience concerned would be more effective and the information well taken (James *et al.,* 2007; Jolly *et al.,* 2009). Kumar *et al.* (2008) opined that enlightening food dealers as well as the general public in a language they can easily understand with the aid of suitable features and food materials would enhance easy diffusion of the knowledge of what aflatoxins are and the extent of damage they can cause to the public. Furthermore, studies by Wagacha & Muthomi (2008); Hell & Mutegi (2011)**;** Magembe *et al.* (2017) proposed that management practices such as dry weather, near crop maturity, temperature, high moisture during harvest, inadequate drying and storage of crops, drought stress control, early harvesting and proper cleaning of agricultural produce should be greatly encouraged as these practices help remove or reduce to the lowest degree conditions and factors that promote fungal infestation and aflatoxin infection. Rapid drying of agricultural products to low moisture level is unwarranted as it creates favorable conditions for fungal growth and proliferation. Hell and Mutegi (2011) acknowledged that proper drying of cereals and legumes soon after harvest to moisture level of about 10% may help limit Aspergillus flavus proliferation and toxin production. Discoveries by Commission (2004) revealed that crop rotation helps reduce aflatoxin prevalence in crops by breaking the cycles and build-ups of toxin-producing microorganisms and cultivation of resistant varieties supports control of the spread of the toxin.

The creation of awareness without proposing realistic controlling opportunities can

generate consumer anxiety and doubt (Anthony *et al.,* 2012). It is worth knowing that farmers may be conscious of the problem but simply do not have the means to improve on the practices. Since farmers (both crop and livestock) are key stakeholders and the first target group in the aflatoxin control chain, it is commonly accepted that priority should be given to building their capacity for adopting good agricultural practices (GAP) (Hell *et al.,* 2010). The awareness of farmers is meant to improve the knowledge base on aflatoxin contamination and its control. The study therefore, assessed farmers' knowledge level and control of aflatoxin contamination in cereals and legumes crops in Jos South Local Government Area, Plateau State, Nigeria. Specifically, the study described the socio-economic characteristics of the cereals and legume farmers in the study area; identified farmers' knowledge level on aflatoxin contamination and assessed control measures against aflatoxin contamination.

METHODOLOGY

The study was carried out in Jos South Local Government Area, Plateau State, Nigeria. Jos South is one of the seventeen (17) Local Government Areas (LGAs) of Plateau State. It has an estimated population of about 306,716 (National Population Commission (NPC), 2006). It is 15km south from the State capital Jos. The LGA has four (4) districts namely Vwang, Du, Gyel and kuru. The major ethnic group in the LGA is Berom besides minor settlers like Hausas, Yorubas, Igbos, and other minor tribes in Nigeria. The main occupation of the populace is agriculture and they often engage in petty trading, hunting, mining and brewery of local drinks. The area has very fertile soil suitable for crop production such as potato, sweet potato, maize, millet, 'acha', soybeans groundnut, tomato, carrot and many other varieties of vegetables (tomatoes, cucumber, cabbage, carrot, green beans, pea etc); it also has suitable climate condition which favors the rearing of most animals such as cattle, sheep, goat, pigs, rabbits, dogs and poultry farming is quite viable in the area.

The study comprised all households involved in cereals and legumes production and processing in the study area. A sample of 120 respondents was selected using purposive and simple random sampling techniques. First a purposive sampling technique was used to select farm families into intense cereals and legumes producing and processing, secondly a simple random sampling technique was used to select thirty (30) respondents from each district in the LGA to give a total of one hundred and twenty (120) respondents. Data for this study were collected from primary source using a well-structured questionnaire. The questionnaire

contained three sections (A, B and C). Section A described the socio-economic characteristics of the respondents. Section B focused on the farmers' knowledge level on aflatoxin contamination while Section C centered on control measures against aflatoxin contamination. A total of one hundred and fourteen (114) copies of the questionnaire were retrieved from the field and were used for the study. Data were analyzed using descriptive analysis such as mean, frequency and percentage, and inferential statistics (Pearson's Correlation).

Objective one which considered the socio-economic characteristics of legume and cereal farmers was achieved by frequency, percentage and mean from the respondents' bio-data. This includes Sex, Age, Marital Status, Educational Level, Household Size, Primary Occupation, Farming Experience, Farm Size, and Membership of a Farmers' Association. Objective two which determined farmers' knowledge level on aflatoxin contamination was achieved by asking the farmers to tick 'yes' or 'no' to assess their knowledge from the list of statements about aflotoxin contamination. The respondents were allowed multiple responses as they may have had more than one knowledge of the subject under discourse. Based on the rule of thumb, knowledge level was categorized into three as low knowledge with a value of 2, medium knowledge with a value of 4, and high knowledge with a value of 6. A ratio representation of these indicates that variables with percentage value less than 33.3% is low knowledge, while 33.3% to less than 50.0% is medium knowledge, and high knowledge ranges from 50.0% and above. However, objective three that assessed the control measures used by the farmers to combat aflatoxin contamination on the crops was achieved by asking the respondents to tick 'yes' or 'no' to determine the measures they employed against aflatoxin contamination. The respondents were allowed multiple responses as they may have used several control measures. Percentage value that ranges from 50.0% and above was considered.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

Sex

The result in Table 1 disclosed that 65.8% of the respondents were females while 34.2% were males. This implies that women were more in legume and cereal production and processing in the study area. This finding could be because women work somewhat as farmers on their account, unpaid workers on family farms, as labourers on other farms on shared farming services and engage in agricultural enterprises to be economically strong to feed members of

their households. The result agrees with Oguonu (2010) who published that, women had historically used agriculture as one of the strategies to address poverty and improve livelihoods and also maintain the stability and sustainability of their families.

Age (Years)

Result in Table 1 revealed that respondents between ages ≤ 30 – 45 years constituted the majority (80.7%) of the respondents. However, the result presented the mean age of the respondents as 34 years, which indicated that the respondents were young and energetic. This compels greater participation in farming which they can take up as a means of livelihood. The result is in line with the work of Lee *et al.* (2017) who specified that young farmers were more intellectual of aflatoxins in crops than the older crop.

Marital Status

Majority (69.3%) of the respondents were married (Table 1), indicating the importance of marriage institution in the study area. This finding implies that married people are laden with family responsibilities which necessitate their engagement in various economic endeavors in order to raise income to cater for the needs of the family members. The result affirms the finding of Anonguku (2014) that married people are stable in their development effort.

Level of Education

Result in Table 1 depicted that majority (84.2%) of the respondents attended one level of formal education or the other. This suggests that the respondents were formally educated and possibly could be literate. The inference of formal education and literacy is that education enables a farmer take scientific decisions that can improve their economic life and being literate enables the farmer to read, analyze, interpret and adopt concepts that can enhance their lives. Education creates awareness and enables farmers to key into opportunities that can positively influence their production activities on the farm. The result harmonizes with the study of Magembe *et al.* (2017) that educational levels have positive impact on aflatoxin alertness.

Household Size (Persons)

Results in Table 1 showed that 50.0% of the respondents had a household size of 6-10

persons while 49.0% had between 1 and 5 persons. The mean household size was 6 persons. This indicates that the respondents had a relatively large household size which could serve as a source of family labour used in cereal and legume crop production. This agrees with Sidi *et al.* (2017) who stated that large households remove the constraint for labour cost and is needed in traditional production and processing of cereals and legumes.

Major Occupation

Table 1 also reveals that most (65.8%) of the respondents were mainly farmers, 13.2% were civil servants; 11.4% were into petty trading and 9.6% were artisans. This implies that the predominant occupation of the respondents was farming; nonetheless, the respondents were into diverse occupations. Farming as the predominant occupation could be because of the rurality of the area.

Farm Size (Hectares)

A greater population (72.8%) of the respondents had less than or equal to 3 ha, about 21.1% had between 4 and 6, while 6% of the respondents had between 7 and 9 hectares. However, the mean farm size was 3.3 hectares. The results suggest that farmers in the study area are small scale farmers. This is a clear indication that farming enterprise in the study area is family-based. Farmers who possess small farm lands encourage fragmentation and this discourages mechanization. This finding supports the study of Ahmed *et al.* (2016) who recapped that most rural farmers owned farm lands of between 1 and 5 hectares.

Farming Experience (Years)

Result in Table 1 demonstrated that respondents with farming experiences between years ≤ 5 – 10 constituted the major population (74.5%), however, the mean years of farming experience of the respondents was 11 years. This suggested that the respondents were well experienced in legume and cereal crops production and as such can identify and utilize certain management practices and control measures against aflotoxins contamination on the grains.

Table 1: Socio Economic Characteristics of the Respondents (n = 114)

Parameters	Frequency	Percentage	Mean
Sex			
Male	39	34.2	
Female	75	65.8	
Age(years)			
15-30	56	49.1	
31-45	36	31.6	33.7
46-60	19	16.7	
61-75	3	2.6	
Marital Status			
Single	25	21.9	
Married	75	69.3	
Divorce	3	2.6	
Widow	7	6.1	
Household Size (Persons)			
1-5	56	49.1	
6-10	57	50.0	6
11-20	1	0.9	
Level of Formal Education			
Primary	19	16.7	
Secondary	44	38.6	
Tertiary	33	28.9	
Non Formal	18	15.8	
Major Occupation			
Farming	75	65.8	
Civil Service	15	13.2	
Artisan	11	9.6	
Trading	13	11.4	
Farm Size (ha)			
0 – 3	83	72.8	
4 – 6	24	21.1	3.3
7 – 9	7	6.1	
Farming Experience (Years)			
. . .	29	25.4	
6 – 10	56	49.1	10.6
11 – 15	14	12.3	
16 – 20	8	7.0	
21 above	7	6.1	

Farmers' Knowledge Level on Aflatoxin Contamination of Cereal and Legume Crops

Knowledge of what aflatoxins were

Table 2 depicted that 70.2% of the respondents had knowledge of what aflatoxins were. The respondents' high knowledge level of what aflatoxins are could be because of high level of formal education (Table 1) in the study area which possibly had created awareness on what aflatoxins were. Formal education empowers farmers to access and process relevant and helpful information from printed, electronic and other information sources. This result disagrees with the study of Kumar and Popat (2010) that about 74% of farmers did not know what aflatoxins were. Study by James *et al.* (2007) on public information campaign on aflatoxin contamination of maize grains in market stores in Benin, Ghana and Togo publicized poor baseline knowledge of the toxin.

Knowledge on health effects of aflotoxins when consumed

Entries in Table 2 illustrated that 63.2% of respondents knew that aflatoxin contamination had serious health effects when consumed. This observation disagrees with James *et al.* (2007) who submitted that farmers supposed that even if there was aflatoxin, it has no negative outcome on the quality of food and health of the consumer. The finding also disagrees with Matumba *et al.* (2015); Okoth *et al.* (2016) who concurred that primary health care centers in Africa almost never relate liver cancer or other negative health effects to food consumption and aflatoxin.

About 65.8% of respondents knew that aflatoxin had serious effects on crops (Table 2). The result agrees with the study of Wagara *et al.* (2014) who recapped that aflatoxins destroy about 30% of crops yields and deface more than 30% of perishable crops in developing countries by lowering their quality and quantity.

Knowledge on sources through which aflatoxins contaminate crops

Result revealed that low population (25.4%) of the respondents knew that aflatoxins contaminate food crops through poor and improper storage, about (22.8%) knew that insect infestation leads to aflatoxins contaminate food crops, 18.4% knew that contaminated seed can dispose food crops to aflatoxins contamination and only about (13.2%) of the respondents

knew that aflatoxins contaminate food crops through the soil among others (Table 2). This confirms that the respondents had a low knowledge base on the avenues through which aflatoxins contaminate food crops. Beyene *et al.* (2016) reported a general poor knowledge about aflatoxins except in African countries where outbreaks have occurred in the past and noted that this also depends on the level of education.

Table 2: Farmers' Knowledge Level on Aflatoxin Contamination of Cereal and Legume Crops

Farmers' Knowledge Level	Frequency	Percentage
Do you know what aflatoxins are?	80	70.2
Do you know that aflatoxin contamination has serious health effects when consumed?	72	63.2
Do you know that aflatoxin contamination has serious effects on crops?	75	65.8
Do you know that aflatoxin contamination crops through the		
Soil	15	13.2
Contaminated seed	21	18.4
Insect infestation	26	22.8
Poor storage quality	29	25.4
Growth of mold	2	1.8
Seed discoloration	1	0.9
Low soil fertility	6	5.2
High Moisture content	10	8.8
Decaying vegetation	4	3.5

Control Measures against Aflotoxin Contamination of Cereals and Legume Crops

Table 3 presented the control measures utilized by the farmers to mitigate aflatoxins contamination in the study area. The control measures adopted by the respondents include: sorting out of infected and damaged seeds (95.1%), use of certified seeds (94.8%), timely and proper harvesting (88.7%), adequate drying and cleaning of seeds before storage (88.7%), suitable storage system (87.5%), pest control management (85.1%), public awareness campaign (74.6%), cultivation of resistance varieties (72.8%) among others

(Table 3). The result implies that the respondents engaged both field management and post-harvest practices in the control of aflatoxin contamination on grain crops. The result aligns with the work of Afolabi *et al.* (2006); Hell *et al.* (2010) who acknowledged that the use of resistant varieties, timely planting, fertilizer application, weed and insect control, proper drying, cleaning, post-harvest insect control, sorting out of physically damaged and infected grains can reduce aflatoxin levels.

Table 3: Control Measures against Aflotoxins Contamination of Cereals and Legume Crops in Jos South LGA of Plateau State

Control Measures	*Frequency	Percentage
Adequate Storage System	100	87.5
Cultivation of Resistance Varieties	83	72.8
DroughtStress Control	80	70.2
Drying and Cleaning before Storage	101	88.7
Pest Control	97	85.1
Use of Crop Rotation	94	82.1
Timely and Proper Harvest	101	88.7
Public awareness	85	74.6
Removal of Infected Seeds	109	95.6
Sanitation	97	85.4
SortingOut Moldy and damaged Grains	97	85.4
Sorting Out Seeds of Different Sizes	79	69.3
Use of Certified Seeds	108	94.8

*Multiple Responses

Conclusion And Recommendations

Majority of the respondents were females, married and had formal education in a school with major occupation being farming. They have a relatively fair large household size and farming experience. Results revealed that a greater percentage of the respondents had knowledge of what aflatoxins were, others knew that aflatoxins cause serious health effects when consumed and affects crops. Findings of the study indicate that the respondents adopted several control measures to combat aflatoxins contamination which includes: sorting of infected seeds, use of certified seed, timely and proper harvesting, adequate and proper drying, use of resistance varieties, adequate storage system, public awareness

campaign, use of crop rotation among others. The study recommends creation of awareness by all concerned stakeholders on all that lead to aflatoxin contamination of food grains and the risks associated with aflatoxins contaminated food. Farmers and the general public should also adhere strictly to the stated controlling measures of aflatoxin contamination on food grains in the study area.

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