Investigation of Yam Farmers Attitude to the Use and Application of Agrochemicals in the Production of Yam Tubers in Benue State Nigeria

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Abstract
Yams play major roles in religious and cultural heritage of several Nigeria tribes including Benue. However, majority of yam farmers within the study area have to contend with one pest or the other in order to enhance crop yield. The productivity of yam tubers has been faced with challenges of poor soil fertility due to its over use and infestation of pests which contribute to poor quality yields and biodeterioration of tubers particularly in the storage season. The study therefore focused on investigating the attitude of farmers towards the application or use of pesticides in yam production in Benue State. The study employed a survey design selecting three study locations- Otukpo, Tarka and Ukum LGAs of Benue State. Semi structured questionnaires were used to gather opinions from yam farmers. A total of 7,560 respondents were selected using stratified random sampling technique. The data collected were analysed and presented in both tables and charts. The study showed that Benue yam farmers extensively employed the use of pesticides in control of pests but observation showed that most of the farmer population did not follow the recommended guidelines. The study therefore concludes by recommending that farmers should be enlightened on wise handling of agrochemicals, use of proper personal protection outfits, storage and effect disposal of chemicals and the containing vessels. Government should buy and supply yam farmers personal protection kits at subsidised rate. BNARDA in conjunction with professionals in Departments of Crop Protection and Agricultural Science should organize workshops and seminars to enlighten yam farmers on the proper use of agrochemicals in the state. As much as possible expectant and nursing mothers with children should be kept off from farms during chemical applications and strict adherence to guidelines on application of agrochemicals should be observed.
Keyword: *Yam production, Agrochemicals, Yam farmers, Attitude.*

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Introduction

Yam (*Dioscorea* species) is a leading popular cash crop and chief food item in Benue State. Authorities such as [1-2] opined that yams are socially and economically important in terms of food security, cash and medicine. Yam tubers are the major crops and most consumed food crops in Wes Africa. Among the earth's more than 32,000 edible plants, yam is one of the 15 crops that make up the world total food production [3]. Since pre-colonial periods, yam have been serving as both staple food crops and items of local and international trades among the peoples that occupy Benue State today. Yams also play major roles in religious and cultural heritage of several Nigeria tribes including Benue [4-5]. In their studies, [6-7] affirmed that protein content of yam is the highest second only to potatoes and thus providing a much greater proportion of protein intake while contributing more than 200 calories per person per day for the teaming human population in Africa. Besides, yams have higher nutrient values for vitamins E and K and serve as a good source of dietary fiber, potassium, manganese, vitamins C and B6 in the world healthiest foods rating system. These nutrient contents attest to the health benefits of yam especially in reduction of heart and cardiovascular diseases, pre-menstrual syndrome in women especially in conjunction with depression, control blood pressure, blood sugar and weight, and aids health and vitality [6].However, the productivity of yam tubers has been faced with challenges of poor soil fertility [5] due to its over use and infestation of pests which contribute to its poor quality yields and biodeterioration particularly in the storage season. [7] estimated an annual average of 10% loss of yam production in Nigeria. Studies have thus shown that yam farmers apply agrochemicals such as fertilizers and pesticides to reduce losses due to pests and soil infertility [6, 9] and to enhance crop growth.

Authorities such as [3,10] asserted that residues of agrochemicals can affect the quality and safety of food supply. Besides, food stuff that have been contaminated with residues of agrochemicals have been rejected in the international markets [11-13]. [14] found out in their study that yam (*Dioscorea alata* and *D. rotundata*) tubers produced in their study areas of Benue state, Nigeria were contaminated with some residues of agrochemicals.

The potentials for contamination crops including yams start from primary production on the account of agrochemical applications. The farmer's attitude to the use and application of agrochemicals can reveal the level of contamination of the yam tubers and thus engineering preventive and control measures. To this end, this study investigated the attitude of yam farmers to the use and application of agrochemicals in the production of yam tubers in Benue state, Nigeria.

Materials and Methods

Study Area

The study was limited to three (3) Local Government Areas (LGAs) namely; Ukum (UK), Tarka (TA) and Otupko (OT) representing the three Benue State Socio-political zones; A, B and C with headquarters at Zaki-Biam, Wannune and Otukpo respectively [fig 1]. The selection of LGAs sampling locations and sites was on the basis of geographical and economic importance in yam production; ease of accessibility and proximity to access roads. The three LGAs were chosen to get a fair representation of the state. A total of 7,560 farmers randomly selected from study locations formed the respondents for the questionnaires.

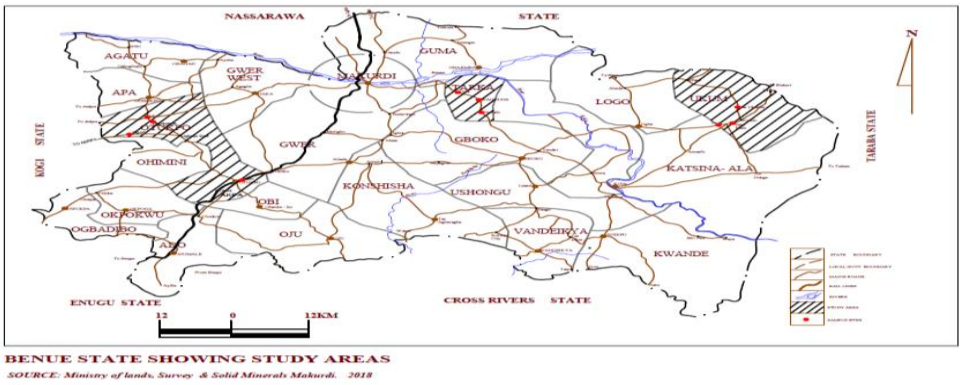


Figure 1. Map of Benue State Showing sample locations

Study Design

This study adopted a survey design which involves the collection of data from a large number of subjects (farmers) to accurately and objectively describe the existing phenomenon [15]. Multistage, random and purposive sampling techniques were adopted [15]. Survey questionnaire- 7,650 hard copies, sample size determination method was adopted.

Data Collection

Stratified random sampling technique was employed. The sample size was divided based on sampling locations (Otukpo, Tarka and Ukum) with each location taking 2,550 respondents, using random sampling. The service of trained research assistants were engaged in order to cover the sample location and size in good time.

Data was collected through personal interviews of yam farmers using a semi-structured questionnaire. Additionally, the activities and behaviour of farmers toward the use of agro-chemicals on the farm were also observed.

Data Analysis

The data generated was subjected to descriptive analysis using Statistical Package for Social Sciences (SPSS) version 20.

Results and Discussion

Demographic characteristics of the respondents to questionnaire related to agrochemicals usage in the production of yam tubers *Dioscorea* species in Benue State.

The study revealed that 6,370 (84.3%) and 1,190 (15.7%) males and females respectively, which summed up to 7560 participants responded to the questionnaire administered to the farmers engaged in yam production in this study. The gender differences were statistically significant (x^2 = 823.28, p = 0.001). This showed that the respondents fell into 5 categories of age brackets. The age categories A-D formed the majority (6,050; 80%) of the participants who were also in their reproductive age brackets, while category E, the minority (1,510; 20%), constituted the none reproductive age group. The mean age of the respondents was 34 ±1.43 years. The differences in the mean of age class were statistically significant (χ^2 = 3989.95 df =8, P<0.001). indicating that, there was an increasing mean value from the lowest educational

qualification to the highest, of the participating yam farmers in Benue State. The differences in the means of educational qualifications of the respondents were statistically significant (χ^2 = 407.61, df = 6, P<0.001, in the favour of holders of higher certificate > of level >primary school> non formal education).

Respondents Level of Awareness of Agrochemical constamination of the environment and yam crops

The results revealed that almost all the respondents (7,050) (93.3%) were aware that agrochemicals could cause contamination or has harmful effect on the environment including crops and animals, including humans.

Pests Infestation on Yams Produced in Benue state

The study further showed that a total of 6,230 (82.4%) of the respondents agreed that yam crops were attacked by pests (OT 2130, 86.2%; UK 1700, 66.9% and TA 2400, 94.1%), the prevalent pests among others included earthworm 160 (2.1%) being the total for the state and occured only in UK, 210 (12.8), millipede (OT 70, 2.8%, UK 70, 2.8% and TA 70, 2.8%), 500 (6.6%), rats (OT 80, 3.2%, UK 0, 0.00% and TA 420 16.5%); 1680 (22.2%), termites (OT 990.40.1%, UK 230, 9.1% and TA 460m 18.0%) and 3,680 (48.7%) yam beetle (OT 990, 40.1%, UK 1240, 48.8% and TA 1450, 56.9%).

Methods of Pest Control Used by Farmers in Benue State

Figure 2 lists the methods of control of yam pests commonly used in the study areas of Benue state; 1040 (13.8%) hand pick (OT 60, 2.4%; UK 240, 9.4% and TA 740, 29%), 720 (9.5%) dust/ash (OT 350, 14.2%; UK 150, 5.9% and TA 220, 8.6%); 4390 (58.1%) use of pesticide/insecticides (OT 1720, 69.6%; 1230, 48.4% and 1440, 56.5%) and 80 (1.1%) biological control which is only being carried out at UK (80, 3.1%).

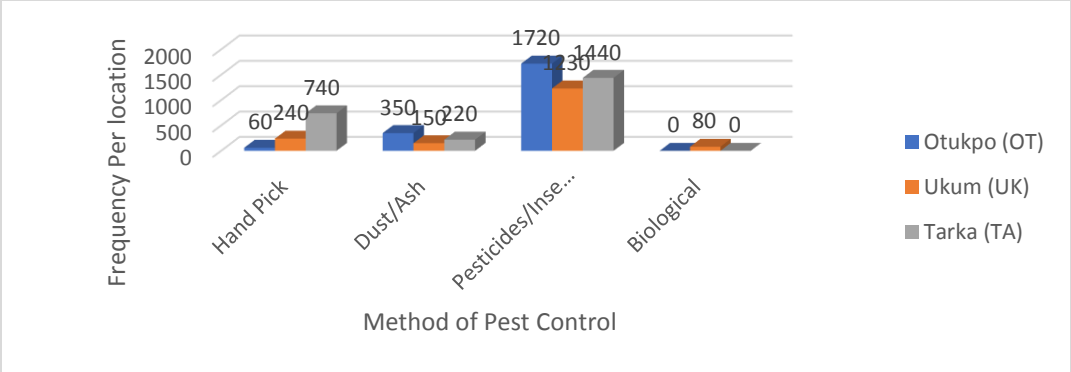


Figure 2: Distribution of Respondents based on methods of control of yam pest in Benue State

Agrochemicals Used for Crop Production in Benue State

Farmers engaged in crop production (yam inclusive) in the study areas in Benue state consented to the use of varieties of insecticides (4,390; 23%), herbicides (7,050; 38%) and fertilizers (7,330; 39%) (fig 3) in crop cultivation. The responses of the respondents revealed the following figures and percentages for the three study locations: OT: insecticides (1,720; 69.6%), herbicides (2,410; 97.6%) and fertilizers (2,410; 87.6%); UK: insecticides (1,230; 84.4), herbicide (2,450; 96.5%) and fertilizers (2,370; 93.3%); and TA:

insecticides (1,440; 56.5%), herbicides (219, 8.6%) and fertilizers (2,550, 100%) (fig 4). Similarly, 3,230 (42.7%) agreed that the residual chemical can contaminate the crops from the soil.

Farmers/Respondents' Attitude to the Use of Agrochemicals Employed in the Production of the Yam Tubers

The study indicated that over half (4,750, 62.8%) of the respondents on an average applied herbicides, fertilizer or pesticides on the same farm per cropping season. While the rest of the respondents (2,810; 37.2%) applied agrochemicals to the same piece of land every cropping season. The statistical test showed an association within locations and frequency of applications of agrochemicals. When the data was subjected to Chi – square statistics, the results showed a statistically significant difference in the frequencies of agrochemical application (x^2 = 453.08, df =2, p<0.001).

Field observation showed that some farmers actually practiced mixed cropping of yam with either maize (*Zea mays*), melon (*Cucumis melo; Citriullus lanatus and Cucumeropsis manni*), okro (*Abelmoschus esculenta)*, pepper (*Piper nigrun, Capicum spp*), beans (*Phaseolus spp, Vigna* spp) and sweet potatoes (*Ipomoea batatas*) among others.

The result equally revealed that, of the (6,214, 82.2%) of the respondents who agreed to have followed the set rules and standards for agrochemical application, only (982.8,13.8%) of them did comply or adhere to the

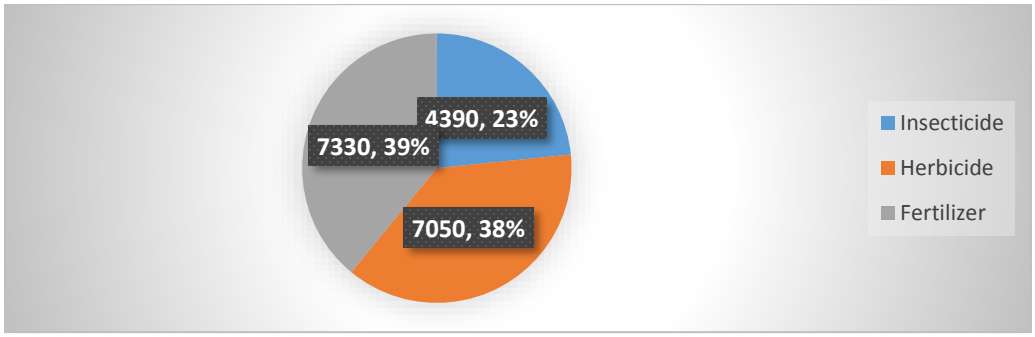


Figure 3: Distribution of Respondents according to Agrochemicals employed by farmers in yam production.

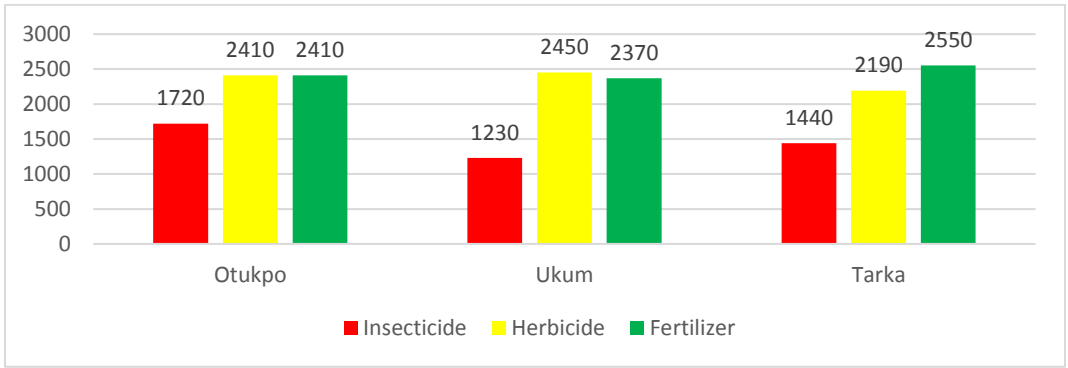
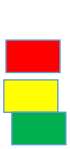


Figure 4: Distribution of Respondents according to the Levels of agrochemicals applications in yam Production



set norms of avoiding agrochemical contamination of soil and the crop. The test of significant association showed a statistically significant relationship between the age of respondents and their choices of AGC handling among yam farmers in the State, x^2 = 1296.71, P≤0.001, with more reproductive age bracket involvement.

The result revealed that more than 2/3 (86.2%) of the respondents agreed to have followed the set rules and standards for agrochemical application. However, only 13.8% of them did not comply or adhere to the set norms of avoiding agrochemical contamination of soil and the crop. The test of significance showed a statistically significant relationship between the age of respondents and their choices of AGC handling among yam farmers in Benue State, χ^2 = 1296.71, P≤0.001.

Field observations indicated that majority of them were completely ill-equipped to handle agrochemicals; with some of the farmers using leaking spraying cans. These cans were dripping the formulated liquid pesticide on their bodies, the crops and the field directly as they went about their activity. Furthermore, the unused formulated liquid chemicals were either stored in bottles and kept in the shade or poured away into the runoffs within the farm or nearby running waters.

Precautions Adopted to Prevent A AGC's Contamination and Poisonings in Benue State

The responses of respondents on compliance with rules for application of AGCs showed that 6,520 (86.2%) persons complied with the rules among yam farmers in Benue state; while only 1,040; 13.8% persons did not; 5,480; 72.6% persons accepted wearing two or more special outfits during application of fertilizers, while 2,070;27.4% did not wear any.

Exposure of the inhabitants of Benue State to AGC

The responses of the respondents to questionnaire on family members involved in handling of AGCs revealed that Almost every inhabitant in Benue state was exposed to AGCs. The responses by age bracket were as follows: 20 years and above 1,500; 19.8%; 21 – 35 years: 4,370; 57.8%; 36 – 50 years; and 51 years and abov: 1,250; 16.5%.

Furthermore, the questionnaire item on where AGCs are kept before and after use recorded the following responses: kitchen: 220, 2.9%; toilet 160, 2.1%; hidden in the room 1,720; 22.8%, while 4,960; (65.6%) agreed to keep the chemicals in the store.

Discussion

Involvement of youth of reproductive age bracket with male dominance in yam production activities that involved agrochemical use in Benue State, implies that, higher proportion of male Benue inhabitants may be exposed to agrochemical contamination and the effects on their general health, reproduction and economic productivity, could be disastrous.

Male dominance in yam production is common in many yam producing belts in Nigeria and elsewhere. The reasons being that, yam enjoys the highest level of acceptance and whose provision is a must for every house holder. [4,16] works revealed higher (73% and 76.43%) male gender involvement in economic production activities of yam tubers in Logo and Otukpo Local Government Areas respectively that expose

them to agrochemical contamination. A much higher percentage (99%) male dominance in yam production in this present work agrees with that reported by [17].

Field observations showed mixed functions between sexes in some cases, with females involving in virtually all the activities including the handling of agrochemicals as confirmed by [18]. This invariably may also expose mothers, the unborn and sucking babies to agrochemical poisoning and the attendant health effects. Up till this time, the productivity of yam tubers has been faced with challenges of poor soil fertility [5,19] due to its overuse and pest infestation which contribute to poor quality yields and biodeteroriation of tubers particularly in the storage period. The study observed that yam tuber production in the study areas was severely attacked by various pests with 82.4% of the farmers agreeing to have suffered the menace. This report is in consonance with [16], who found that 82.14% of farmers in Logo Local Government Area of Benue State experiences incidences of pests and diseases that negatively affected their yam production. [20] stated that, pre and post-harvest crop losses are due to parasitic nematodes, insects and weeds.

Yam production does well in virgin land which involves the conversion of natural ecosystem to habitat management, destruction and disruptive processes such as land clearing and bush burning that ultimately upsets natural equilibrium in favour of pest organisms that are destructive to crops of farmers. Abundance of food resources and absence or low level of their natural enemies' influence pest population positively both in number and their economic damage to the crops [21-22].

Prevalent pests as indicated by Benue farmers in this work included: yam beetles (*Heteroligus meles*) > rats (*Rattus rattus Cricetomys Gambianus* and *Mus musculus*). The field observation further revealed infestation of yam tubers by crickets (*Gymonogry lucas*), Nematodes (*Scutellonema bradys*), yam tubers dry and wet rots which may be due to fungi (either *Fusarium, Rhizopus, PeniciIlium* or *Aspergillus* spp) complexes, nematode (*Meloidogyne* spp), yam sealers (*Asphidiella hastil*), spear grass (*Imperata Cylindrica* (L) Beauv).

More than half (62.8%) on the average, applied agrochemical twice or more on yam crops every cropping season. The statistical test further showed an association between location and frequency of application at P=0.001, an indication of significant utilization of chemicals and consequent impacts on farmers within the study area; which invariably could pollute the soil, water, air and crops.

The indiscriminate use of agrochemicals has affected the entire ecosystem and microorganisms and the soil. Furthermore, [21] observed that, pesticides accumulation in the soil causes biomagnification in plants and animals with attendant health problems and may even kill fishes in the water, wild life such as guinea fowl, toads, snails and other biotic agents.

Family labour and higher education were among the indices that positively influenced yam production [23]. Educated farmers as witnessed in this work, all things being equal were supposed to carefully read, comprehend and follow detailed instructions and guidelines on the labels of packages of chemicals about the use-formulation, applications and disposal of same as well as being adequately protected including crops and the overall environment against chemical contamination [24]. Agrochemical literacy aims at safeguarding good quality crops and products, ensure safe nutrition, consumption and boost international patronage [11,24,25].

Almost all respondents (93.3%) were aware that agrochemicals could cause contamination of crops, animals, and humans. Positive associations (P ≤0.05) were found between respondents knowledgeable about agrochemical contamination and those who were not, based on gender, age groups, and educational attainment. However, there was a wide gap between the farmers' knowledge of agrochemicals contamination and the environmental impacts, and the attitude towards the use of the same, among the sampled population. Of 2/3 (86.2% and 72.6%) of farmers who agreed to follow acceptable instructions and the use of one or more special outfits during chemical formulation and spraying operation to avoid contamination, field observations revealed that, **not one of the observed farmers used complete personal protective outfits.** (hat, goggles, mouth/nose mask, boot thick long sleeve and trouser).

Moreover, food and utensils brought to the farms were not properly protected to avoid contact with the chemicals during operation. Some did not wash their hands before meals that were equally kept anyhow and anywhere on the fields being sprayed. When the researcher advised a particular operator, his response was, “there will be no problem”. Moreover, there were cases of licking and splashing of chemical solutions on operators who hardly wore thick clothing, with sprayers hung on partially covered body. While spraying was on going, family members and farm labour were seen doing other jobs and even eating on fields that were being sprayed.

The findings of this work affirmed the assertion of [26], that agrochemical residues normally enter into food products such as yam tubers (*Dioscorea* spp) by direct use of fertilizers and pesticide and indirectly, through runoff and air drifts. It was observed too, that yam farmers in Benue State formed part of such ecological cycles of agrochemical contamination in Benue environment that had before now negatively influenced safety and quality of her yam tubers which suffered rejection in the international markets along with other Nigerian crops [27].

Almost all (7,050, 93.3%) yam farmers in Benue State accepted using agrochemicals for yam tubers production. The agrochemicals sultility were fertilizers, herbicides and insecticides at the levels of 39% 38% and 23% respectively. The high level use of fertilizers and pesticides in this study is a confirmation of [28] who showed increased use of agrochemical with increasing population. This is also an indication that, Benue soil fertility could not support yam tubers production without artificial soil nutrient supplement confirming the recent assertions by [5,19] that, Benue soil infertility was caused by over cropping of cash crops during the colonial occupation of the Benue Valley Basin of Nigeria. However, the result contradicts the finding of [22] in Taraba State who showed that relatively low level of usage (below 50%). Over doses of chemical application witnessed in mixed cropping farms in this work could lead to ecological imbalance in Benue environment. [29-30] testified of residues being dictated in all segments of the environment and have shown potential of bio-magnification and accumulation in animals’ tissues including man.

Another interesting finding of this study was the ways and manners in which AGCs are disposed. Majority of the farmers kept unused formulated chemicals for future use, while others discarded the remnants on the farm and very few persons poured the AGCs into flowing or any body of water. The containing vessels or packages of agrochemicals were either thrown away, burnt, or washed and reused as house hold containing vessels.

These findings showed that Benue people and environment may not be devoid of agrochemical contaminants as their handling and disposals were haphazardly done. The findings are in line with [31] who highlighted the factors of agrochemical misuse and or unsafe use especially in developing countries to include the followings among others; use of leaking equipment, exposure to pesticide drifts, failure to wear personal protective equipment, storage of chemicals in family bedrooms and in unlocked cabinets, improper disposal of empty containers, use of empty containers for domestic purposes such as storing foodstuffs and water for both human and domestic animals.

Conclusion

Yam tubers play a significant role in human diet, however, its production is not without challenges. The storage losses as estimated was between 80 to 100%. If the bio-deterioration as well as other forms of tuber losses are not checked, yams would lose its prestigious position as part of pillar of food security [2,16] both within the state and elsewhere. The Findings in this study have shown that, yam cultivation in the state is not devoid of pest infestation and yam farmers within the study locations have employed extensive use of fertilizers and pesticides to enrich soil nutrients and in the control of pests. Though the results showed a fair knowledge and positive attitude of respondents on the use of agrochemicals, more needs to be done

with respect to safe practices that will enhance the safety of both farmers and yam crops as well as curtail the bio-deterioration of farmlands.

The study therefore concludes that farmers should be enlightened on wise handling of agrochemicals. Government should buy and supply yam farmers personal protection kits at subsidised rate. BNARDA in conjunction with professionals in Departments of Crop Protection and Agricultural Science should organize workshops and seminars to enlighten yam farmers on the proper use of agrochemicals in the state. As much as possible expectant and nursing mothers with children should be kept off from farms during chemical applications. Strict adherence to guidelines on safe application of agrochemicals should be observed.

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