Bima Journal of Science and Technology, Vol. 8(2B) July, 2024 ISSN: 2536-6041

DOI: 10.56892/bima.v8i2B.722

Impact of Farmers' Knowledge and Agricultural Practices on the Occurrence of Fungal Diseases in Pepper Crops within the Northern Guinea Savannah Ecological Zones of Nigeria

Zakari B. G.[1] Chimbekujwo I. B.[1], Jimeta Z. G. and Usman Talba[2]*

[1]Department of Plant Science, Modibbo Adama University Yola, Nigeria
[2]Department of Integrated Science, College of Education Waka Biu, Borno State, Nigeria

Corresponding Author: usmantalbal@gmail.com

ABSTRACT

Pepper (*Capsicum* spp.) is cultivated in the Northern Guinea Savannah ecological zone of Nigeria which faces significant challenges due to the prevalence of fungal diseases. This study identified the agronomic practices influencing the occurrence and intensity of these diseases. Conducted in Jalingo and Yola from May 2019 to October 2020, the research incorporated a household survey and a field survey to comprehensively assess the dynamics of the disease. The majority of farmers (37.5%-40%) were aged 31 - 40, predominantly young and middle-aged. A significant gender disparity existed, with 97.5 % - 100 % male farmers. Married farmers comprised 65 % - 70%, indicating family labor availability. Lack of formal education was notable, with 60 % - 47.5 %. The average household size was 8 persons, supporting family labor. Occupation-wise, 47 % - 57 % were traders, 40 % - 30 % relied on farming, and 5 % each were civil servants. Seed sourcing revealed 60 % - 42.5 % used seeds from their farms, and 5 % - 10 % used certified seeds. Mixed cropping was prevalent (57.5 % - 62.5 %). Crop rotation involved tomatoes or garden eggs (40 % - 42.5 %). Synthetic pesticides were used by 57.5 % - 60 %, while 22.5 % - 27.5 % controlled weeds regularly. The study emphasizes the high prevalence of fungal diseases, especially vascular wilt and anthracnose, in pepper crops. Farmers, facing financial constraints and limited education, were engage in practices contributing to disease spread. Education and sensitization initiatives will enhance agronomic practices and minimize disease spread, aiming at sustainable pepper production in the zone.

Keywords: Pepper cultivation, Agronomic practices, Demographic patterns, Vascular wilt, Anthracnose disease.

INTRODUCTION

Pepper, scientifically known as *Capsicum* spp., is a vegetable crop belonging to the Solanaceae family. It is believed to have originated from tropical America and Africa (Aliyu *et al*., 2012). Farmers worldwide cultivate pepper for both food and economic purposes, with its demand significantly rising in recent years (International Pepper Conference (IPC) Proceedings, 2012). Pepper has the potential to generate foreign exchange for Nigeria, the use of peppers in confectionery, medicine, and culinary applications is on the rise (FAOSTAT, 2020). The moderate pungency of Nigerian chilli pepper makes it suitable for spice blends and pharmaceutical use (Suleiman and Isah, 2010).

Globally, Vietnam is the largest pepper producer. Nigeria and Ghana are the largest pepper producers in West Africa, ranking eighth and thirteenth globally (FAOSTAT, 2020). Despite having fertile soils, favorable weather, and available land, Nigeria's reported yield of 8.4 t/ha is lower than the estimated yields of 15 t/ha in Western Europe. Constraints such as diseases, pests, and poor

DOI: 10.56892/bima.v8i2B.722

weed management were initially blamed for the low yields (Jaliya and Sani, 2006; Zakari *et al*., 2016). The primary pepper-producing regions in Nigeria are the Guinea and Sudan Savanna zones, particularly in northern states like Kaduna, Kano, Katsina, Kogi, Kwara, Yobe, and Zamfara (Grubben and Tahir, 2004).

Peppers in Nigeria and other sub-saharan Africa faces a serious challenge of biotic stresses caused by fungal pathogens, posing threats throughout their growth stages, transportation, marketing, and storage (Olawale *et al*., 2015; Asare-Bediako *et al*., 2015). Fungi genera like *Colletotrichum*, *Phytophthora*, *Cercospora*, *Verticillium*, *Fusarium*, and *Aspergillus* contribute to diseases such as seed and fruit decay, anthracnose, fruit rot, phytophthora blight, and cercospora leaf spot. It is widely believed that the prevalence of fungal diseases is linked to the adoption of suboptimal agronomic practices by farmers, compounded by financial constraints and low levels of education in developing countries (Mohammed *et al.,* 2016; Zakari *et al*., 2016).

In view of the above problems and the need to understand the dynamics of fungal diseases in pepper cultivation within the region, this research work was designed to identify the agronomic practices of farmers that impact the occurrence and intensity of fungal diseases in the Northern Guinea Savannah ecological zone in Nigeria,

MATERIALS AND METHODS

Study Area

This research was carried out in Jalingo, Taraba State and Yola, Adamawa State (Figure 1), Nigeria, from May 2019 to October 2020. The study areas are situated within the Northern Guinea savannah ecological zones, characterized by distinct wet and dry seasons. The geographical coordinates range from latitudes 8^{o} 47' to 9° 19'N and longitudes 11^{o}09' to 12°30'E. According to the data obtained from Upper Benue River Basin Development Authority (UBRBDA) (2020), the wet season typically extends from late April to October, while the dry season spans November to March. Both locations experience an annual mean rainfall of about 1,200 mm, a mean temperature of approximately 29^{o} C, and varying relative humidity, ranging from 60–70 % in the wet season to 35–45 % in the dry season. The soil composition in these areas is predominantly sandy and loamy.

Experimental Design

The experimental design comprised of two stages following the approach outlined by Asare-Bediako *et al*. (2015). In the first stage, a household survey was conducted using questionnaires. The primary objective was to identify the agronomic practices employed by farmers that could influence the incidence of diseases in their pepper farms. The second stage involved a field survey utilizing a field disease guide. The combination of these two survey stages provides a comprehensive understanding of the relationship between farmers' practices and the prevalence of fungal diseases in pepper cultivation.

Survey on Farmers' Perceptions of Fungal Diseases in Pepper Crops

A total of forty-eight questionnaires were randomly distributed, with three questionnaires allocated to each of the sixteen study sites. These sites comprised eight from Jalingo (Bassa, Kogin Malam Garba, Kogin Siniya, Kogin Sarki, Kogin Korofi, Kogin Yandan, Kogin Magami, and Nukkai) and eight from Yola (Bugare, Geriyo, Malkohi, Namtari, Ngurore, Wafango, Wuro Ishaku, and Wulum).

Bima Journal of Science and Technology, Vol. 8(2B) July, 2024 ISSN: 2536-6041

DOI: 10.56892/bima.v8i2B.722

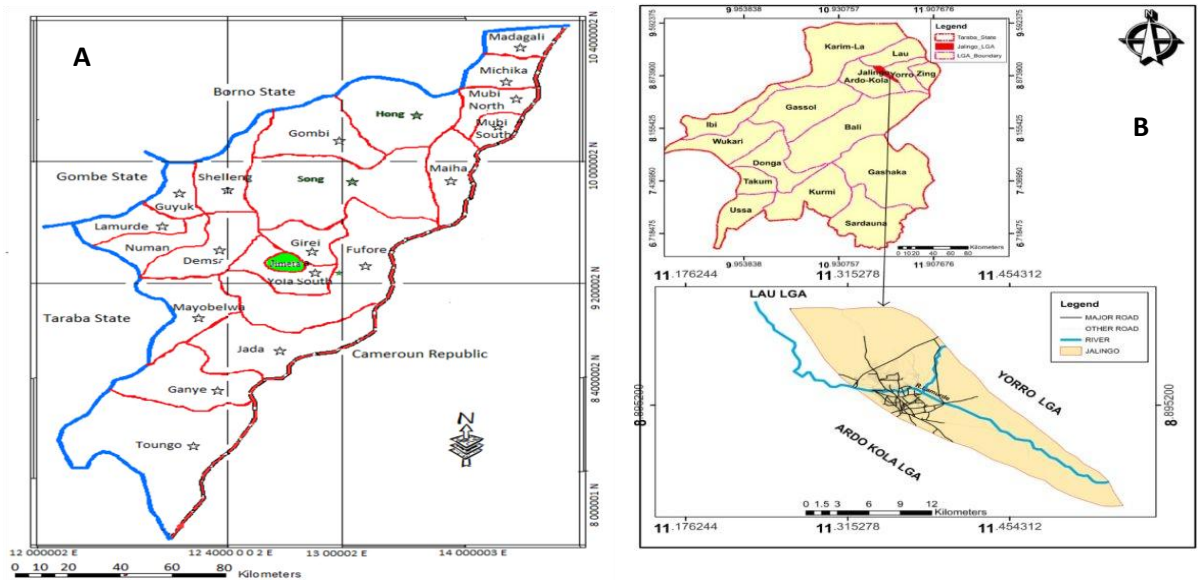


Figure 1: Map of Adamawa (a) and Taraba (b) States Showing the Study Areas (UBRBDA, 2020

Legend
LGA boundary
Yola North LGA
LGA boundary

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) and standard error of means using Paleontological Statistics (PAST) package version 4.07 and means were separated using Fischer's Least Significant Difference (FLSD) at 5 % probability level.

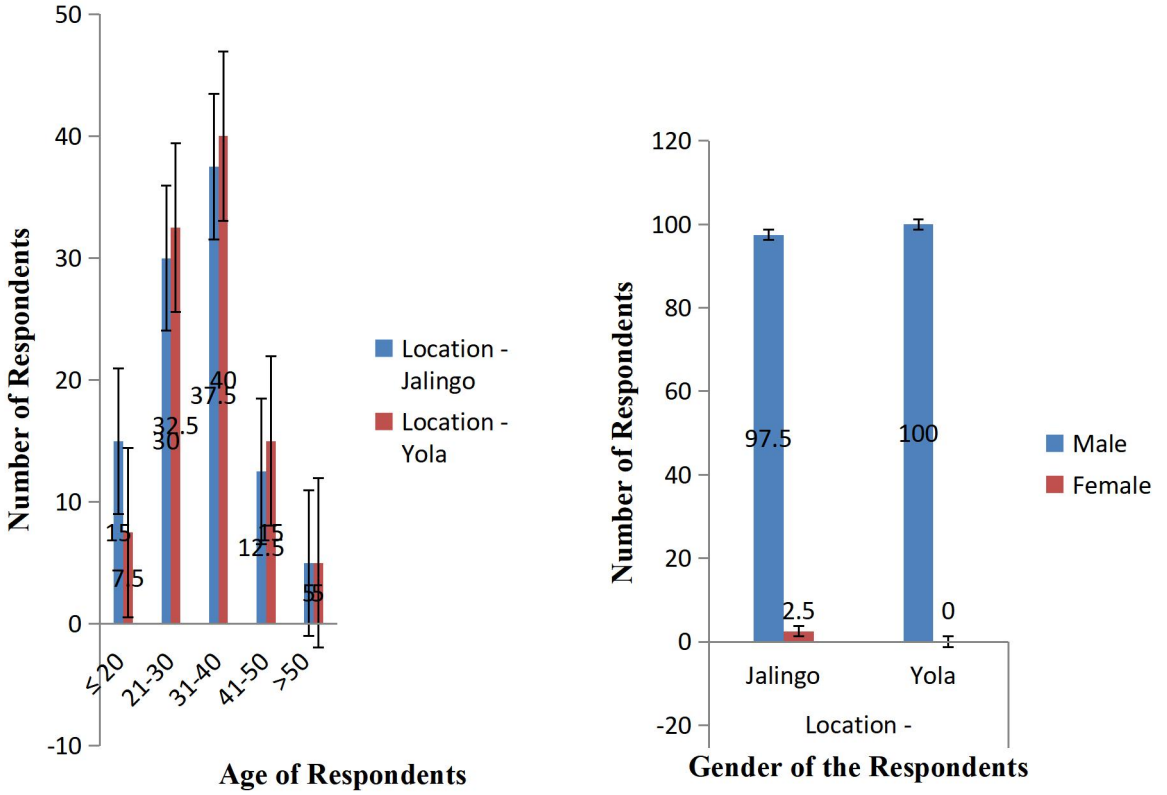
RESULTS

Demographic Characteristics of Farmers

The result indicate that majority of farmers across two locations fell within the 31-40 age range, comprising 37.5 % and 40 % of the farmer populations, respectively (Figure 2a). In Jalingo, 30 % of farmers were in the 21-30 age range, while in Yola, 32.5 % were in the same age group, surpassing the 41-50 age range (12.5% and 15%, respectively). Few farmers in each location were either ≤ 20 years old (15 % to 7.5 %) or above 50 years old (5 % each).

Survey results revealed a significant gender disparity, with the majority (97.5 % in Jalingo and 100 % in Yola) of farmers being male, and only a small percentage of females (2.5 % in Jalingo and 0% in Yola) involved in pepper production (Figure 2b).

DOI: 10.56892/bima.v8i2B.722



(a) **(b)**

Figure 2: Distribution of Pepper Farmers by Age (a) and Gender (b) in Jalingo and Yola

Regarding marital status, 65-70 % of farmers in the study areas were married, while 30-35 % were single, divorced, or separated (Figure 3a). In terms of literacy, approximately 60% and 47.5 % of farmers in Jalingo and Yola, respectively, had no formal education. Meanwhile, 27.5 % and 25 % had primary education, 12.5 % and 25 % had secondary education, and 0% and 2.5 % had tertiary education in the respective orders (Figure 3b).

Bima Journal of Science and Technology, Vol. 8(2B) July, 2024 ISSN: 2536-6041

DOI: 10.56892/bima.v8i2B.722

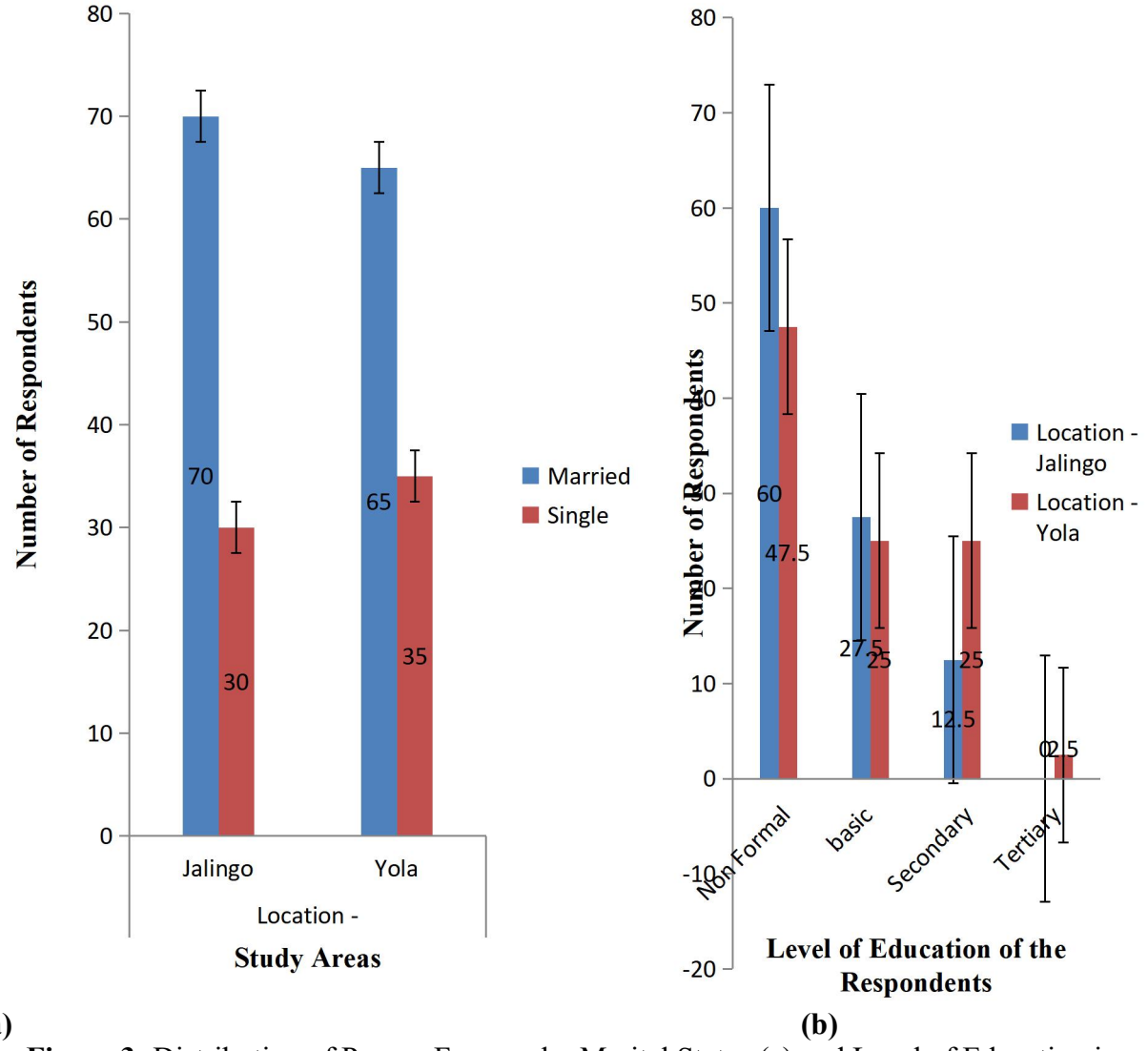
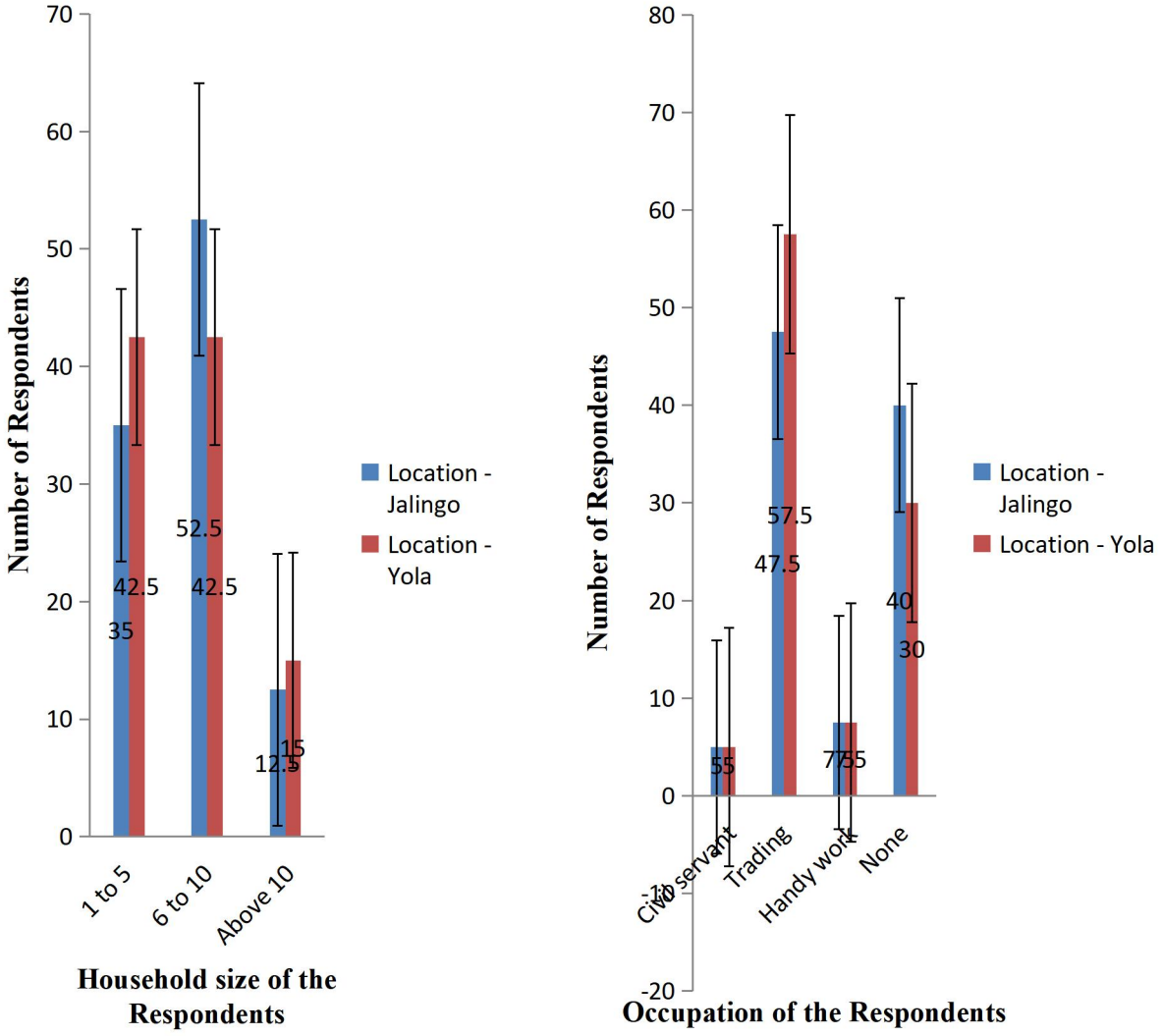


Figure 3: Distribution of Pepper Farmers by Marital Status (a) and Level of Education in Jalingo and Yola

The household size for the majority of respondents was 6-10 persons, with an average household size of 8 persons (Figure 4a). Regarding occupation, a significant percentage (47 % in Jalingo and 57 % in Yola) of farmers were traders, while 40 % and 30 % relied solely on farming, and only a few (5 % each) were civil servants (Figure 4b).

Bima Journal of Science and Technology, Vol. 8(2B) July, 2024 ISSN: 2536-6041

DOI: 10.56892/bima.v8i2B.722



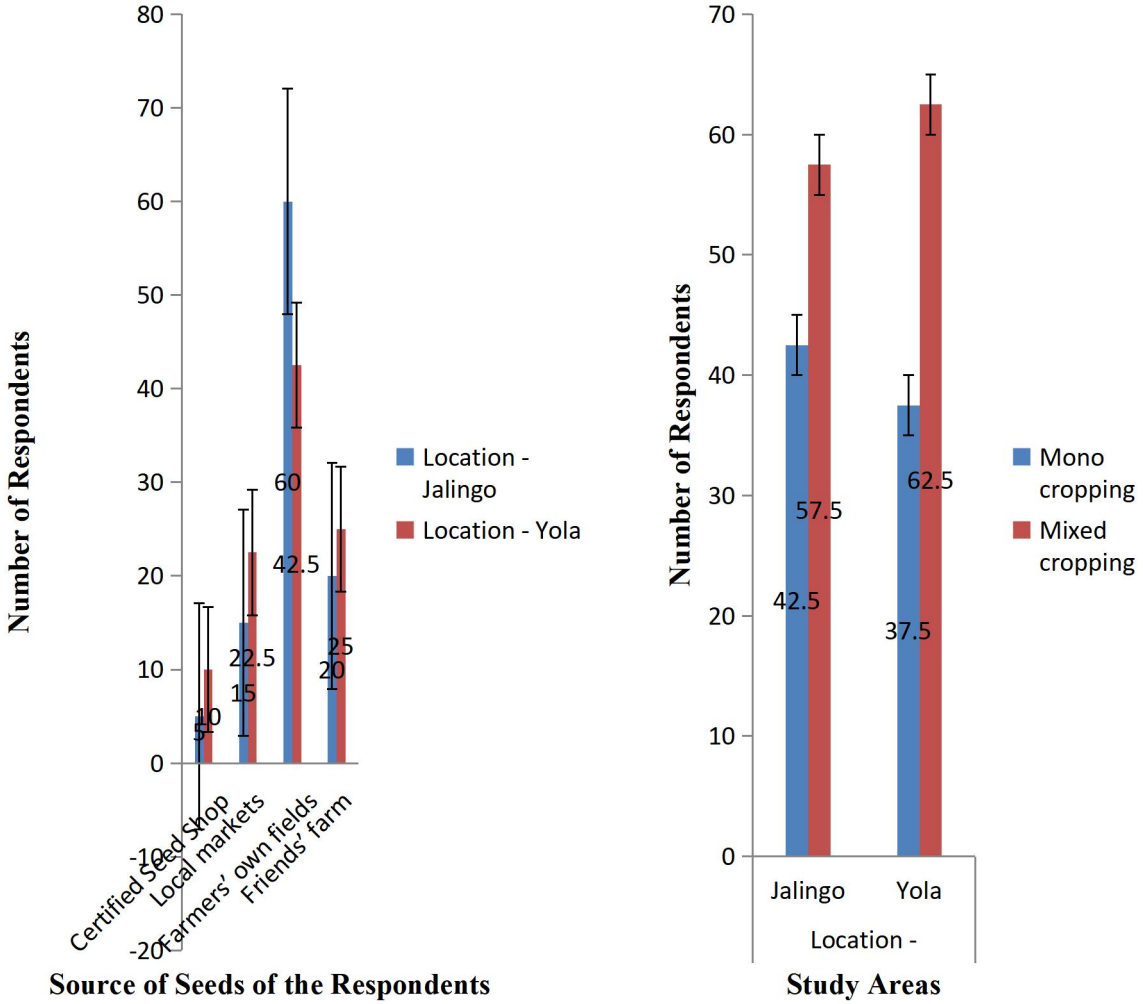
(a) **(b)**

Figure 4: Distribution of Pepper Farmers by Household Size (a) and Occupation (b) in Jalingo and Yola

Farmers' agronomic practices

Farmers in the two surveyed regions relied on various sources for their seeds, with 60 % and 42.5 % (Jalingo and Yola, respectively) were using seeds from their own farms. Additionally, 20 % in Jalingo and 25 % in Yola obtained seeds from friends, while 15 % in Jalingo and 22.5 % in Yola acquired them from local markets. Only 5 % in Jalingo and 10 % in Yola, obtained certified seeds (Figure 5a). In terms of cropping practices, the majority of farmers practiced mixed cropping (57.5 % in Jalingo and 62.5 % in Yola) (Figure 5b).

DOI: 10.56892/bima.v8i2B.722

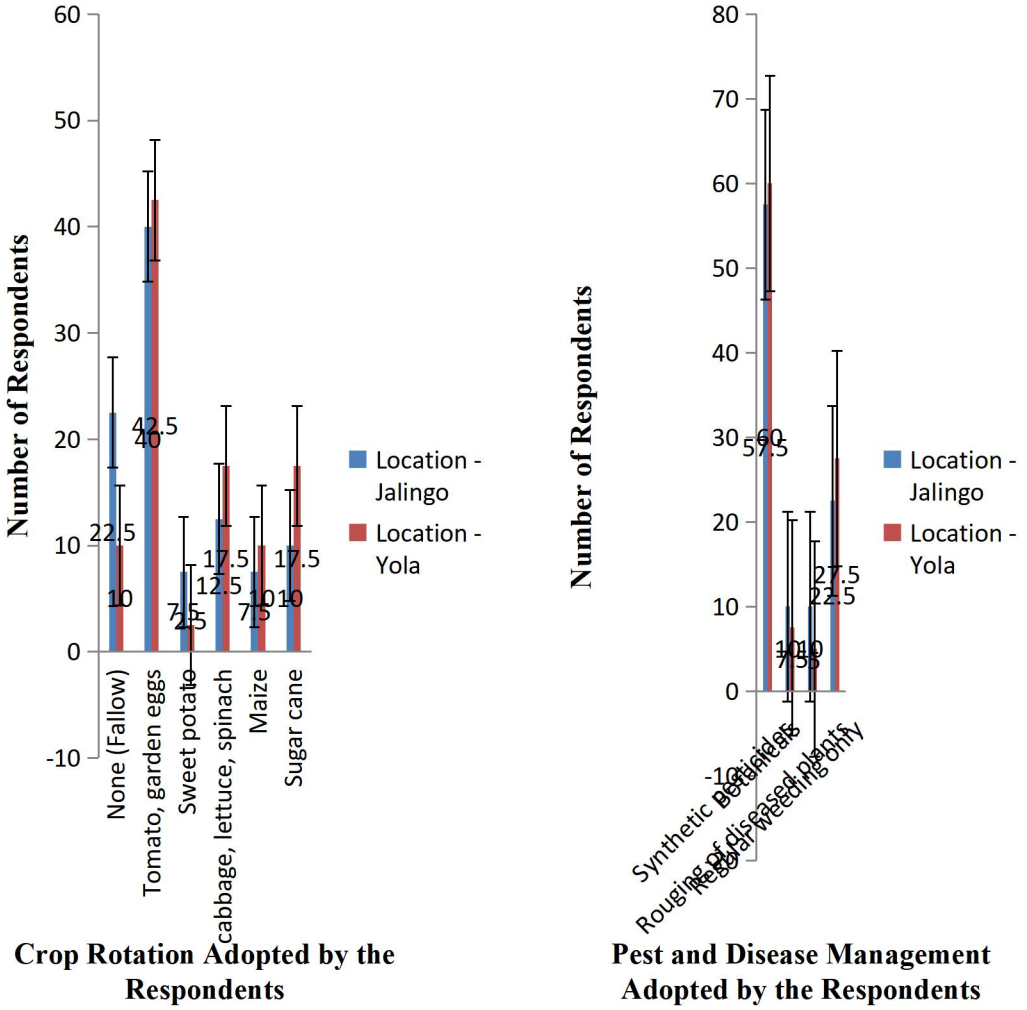


(a) **(b)**

Figure 5: Pepper Farmer's Source of Seeds (a) and Cropping Patterns (b) in Jalingo and Yola

Others engaged in mono cropping (42.5 % in Jalingo and 37.5 % in Yola). On the crops rotated with pepper, most farmers mentioned tomatoes or garden eggs (40 % in Jalingo and 42.5 % in Yola). Others rotated pepper with other crops (37.5 %) in both regions (Figure 6a). Additionally, 22.5 % of farmers in Jalingo and 10 % in Yola practiced land fallowing. The majority of farmers (57.5-60 %) in both areas used synthetic pesticides, while a smaller percentage utilized botanicals (7.5-10 %), rogue diseased plants (5-10 %), and regularly controlled weeds (22.5-27.5 %) in disease management (Figure 6b).

DOI: 10.56892/bima.v8i2B.722



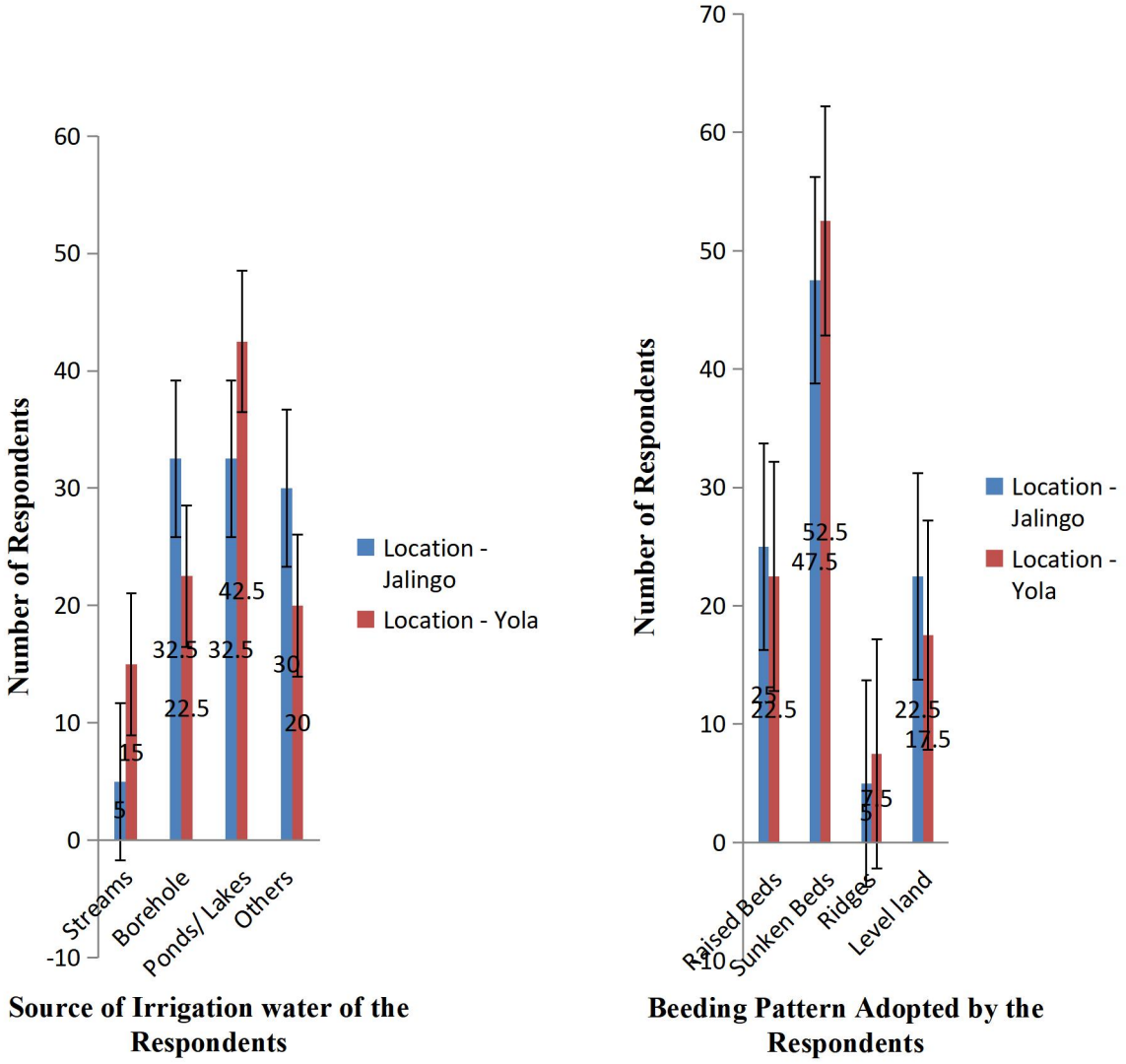
(a) **(b)**

Figure 6: Crop rotation (a) and Pest and Disease Management (b) practices adopted by Pepper Farmers in Jalingo and Yola

Regarding irrigation water sources, 60-65 % of farmers in both regions obtained water from ponds, lakes, local boreholes, or dams. Only a few sourced water from streams and rivers (5-15 %), while 30-35 % of farmers used alternative sources like tap water, wells, among others (Figure 7a). In terms of bedding patterns for pepper seedlings production, the majority adopted sunken beds (47.5 % in Jalingo and 52.5 % in Yola), with 17-25 % using raised beds and level lands, and only about 0.5% employing ridges in the surveyed areas (Figure 7b).

Bima Journal of Science and Technology, Vol. 8(2B) July, 2024 ISSN: 2536-6041

DOI: 10.56892/bima.v8i2B.722



(a) **(b)**

Figure 7: Source of Irrigation Water (a) and Bedding Pattern (b) adopted by Pepper Farmers in Jalingo and Yola

DISCUSSION

The global production of pepper (Capsicum spp.) faces significant challenges from fungal diseases, particularly in Adamawa and Taraba States of Nigeria, where farmers often lack awareness of the detrimental effects of these diseases. A notable trend in pepper farming is the predominant involvement of young individuals aged 31-40. Observations similar to this was reported by by Agbamu's (2014) in Delta State, showing that 37 years was the average age of farmers, constituting 34.27 % of those surveyed. The inclination of young men towards pepper farming in these regions may stem from the perceived profitability of the venture. As reported by Omotayo *et al.* (2012, the pepper offers quick returns, with the potential for repeated harvests over three to five months, making it an attractive commercial option for young farmers.

DOI: 10.56892/bima.v8i2B.722

The cultivation of pepper is largely carried out by men in Jalingo and Yola, potentially influenced by the crop's increasing commercial value and flexible income prospects. A study on the participatory evaluation of exotic pepper cultivars among smallholder farmers in Southwestern Nigeria revealed that 64% of surveyed farmers were male, while 34% were female (Omotayo *et al*., 2015). Moreover, marital status data indicated that a majority of farmers in Jalingo and Yola are married, suggesting the availability of family labor to support pepper farming activities in these areas.

The majority of farmers in Jalingo and Yola lack formal education, with less than 3% having tertiary education. This contributes to a high incidence of fungal diseases across the study areas, as the low literacy rates hinder farmers from accessing information on new agricultural innovations for improved productivity and disease management. Lewis and Miller (2004), linked the low educational levels of farmers to their reluctance to adopt enhanced agronomic practices like removing diseased plants, clearing crop residues, and eliminating alternative host plants carrying pathogens. Knowledge about disease management is crucial for controlling and preventing the spread of diseases (Agrios, 2005).

Over half of the respondents have households with multiple members, a common situation in Nigeria (Adeoye *et al*., 2012). This suggests that family labor is readily available for pepper farming operations. Regarding occupation, the majority of farmers are traders, with only a few working as civil servants. While these farmers may not receive a salary, the prevalence of trading implies that money may not be a significant obstacle, as traders typically have income. Zaini *et al*. (2020) reported that, a strong correlation between a farmer's economic status and their ability to manage diseases.

The investigation uncovered that a majority of farmers acquire seeds from uncertified sources and engage in mixed cropping. The suboptimal agronomic practices employed by pepper farmers likely contribute to the high occurrence of diseases in the regions. This aligns with the findings of Asare-Bediako (2015), who asserted that farmers' agronomic practices influence the prevalence and intensity of crop diseases. The utilization of planting materials from previous crops contributes to the transmission of seed borne fungal diseases, such as Phytophthora blight, Anthracnose, and Cercospora leaf spot (Chaube and Pundhir, 2005; Agrios, 2005; Amusa, 2004).

Surveying farmers about crop rotation practices revealed that a majority focus on rotating paper with crops of same family, while some practice monocropping. Monocropping and crop rotation practices likely contributes to the widespread and severe occurrence of pepper diseases in the areas. Monoculture, characterized by genetic uniformity and dense populations, can lead to rapid epidemic spread of diseases once established (Obeng-Ofori, 2007; Arya, 2002).

Despite the majority of farmers in Jalingo and Yola resorting to chemical pesticides for disease control, the study observed high disease incidences and severities. This may be attributed to the over-reliance on pesticides leading to the development of resistance in targeted pests and pathogens (Ciancio and Mukerji, 2007). Additionally, the use of broad-spectrum pesticides may inadvertently eliminate beneficial organisms that normally control diseases, surpassing the economic threshold level (Ciancio and Mukerji, 2007).

Many pepper farmers in Jalingo and Yola rely on unclean water sources for irrigation, using

DOI: 10.56892/bima.v8i2B.722

sunken beds in pepper cultivation. These practices may be a contributing factor to the introduction of pathogenic organisms, leading to a high incidence of diseases in the farms, as it may wash away disease propagules and introduce them to other fields (Agrios, 2005; Asare-Bediako, 2015).

The study areas experienced high occurrences and severities of anthracnose, damping off, stem rot, and vascular wilts. Similar diseases, including phytophthora leaf blight and cercospora leafspot, have been identified in pepper fields in other regions of Nigeria (Olawale *et al*., 2015), Uganda (Nsabiyera *et al*., 2012), and Ghana (Asare-Bediako *et al*., 2015), confirming the prevalence of these diseases in sub-Saharan Africa.

CONCLUSION

The study indicates a significant prevalence and severity of anthracnose, vascular wilt, damping-off, and stem rot diseases in pepper crops within the research areas. The majority of farmers in the study areas have low incomes, lack formal education, obtain seeds from uncertified sources, engage in both monocropping and mixed cropping, and use synthetic pesticides to manage diseases. The identified fungal pathogens, including *Aspergillus niger, Colletotrichum capsici, Fusarium oxysporum, Fusarium solani*, and *Poma* species. Based on these findings, it is recommended that the Adamawa and Taraba State governments, through their Ministries of Agriculture, undertake initiatives to educate farmers on effective agronomic practices in pepper production. This educational effort aims to minimize the spread of diseases within pepper fields in the region.

REFERENCES

Adeoye, I. B., Fashogbon, A. E., and Idris, B. A. (2012). Analysis of technical efficiency of pepper production among farmers in Kano State, Nigeria. Proceedings of the 30th Conference of the Horticultural Society of Nigeria, 11-15 Nov. 2012, Owerri, Nigeria.

Agbamu, J. U. (2014). Preferred Sources of Information Used by Cassava Farmers in Delta State, Nigeria. *Asian Journal of Agricultural Extension, Economics and Sociology*, 3(4), 365-372.

Agrios, G. N. (2005). Plant Pathology (5th ed.). Elsevier Academic Press. Amsterdam, 26-27,398-401

Aliyu, L., Yahaya, R. A., Arunah, U. L., and Haruna, I. M. (2012). Response of Two Chilli Pepper Varieties (Capsicum Frutescens L.) To Harvesting Frequency. *Elixir Agriculture*, 42, 6493-6495.

Amusa, N. A., Kehinde, I. A., and Adegbite, A. A. (2004). Pepper Fruit Anthracnose in the Humid Forest Region of South-western Nigeria. *Nutrition and Food Science,* 34(3), 130-134.

Arya, A. (2010). Recent Advances in the Management of Plant Pathogens: Botanicals in the Fungal Pest Management. In A. Arya and A. E. Perello (Eds.), Management of Fungal Plant Pathogens (pp. 1-25). Centre for Agriculture and Biosciences International.

Asare-Bediako, E. A., Addo-Quaye, A., Boakye, B., Sarbah, J. M., Asante, P., and Dorm E. (2015). Incidence and Severity of Viral and Fungal Diseases of Chili Pepper (Capsicum Frutescens) in Some Districts in Ghana. *International Journal of Plant and Soil Science*, 7(3), 147-159.

Chaube, H. S., and Pundhir, V. S. (2005). Crop diseases and their management. Prentice Hall of India Private Ltd.

Ciancio, A., and Mukerji, K. G. (2007). General Concepts in Integrated Pest and Disease Management. Springer. 78-81.

DOI: 10.56892/bima.v8i2B.722

FAO. (2020). FAOSTAT Database. Food and Agriculture Organization. Retrieved from www.fao.org (retrieval date 8th November, 2019

Grubben, G. J. H., and Tahir, I. M. (2004). Capsicum species. In G. J. H. Grubben and O. A. Denton (Eds.), Plant Resources of Tropical Africa. Vegetables. PROTA Foundation.

International Pepper Conference (2012). Proceedings of 21st International Pepper Conference, Florida, USA.

Jaliya, M. M., and Sani, B. M. (2006). Pepper Production under Irrigation. National Agricultural Extension Research Liaison Services, Ahmadu Bello University, Extension Bulletin No. 206, Agricultural Engineering series N.

Lewis, W. H., and Elvin-Lewis, M. P. (2003). Medical Botany: Plants Affecting Human Health (2nd ed.). John Wiley and Sons.

Mohammed, B., Abdulsalam, Z. N., and Ahmed, B. M. (2016). Profitability in Chilli Pepper Production in Kaduna State, Nigeria. *British Journal of Applied Science and Technology*, 12(3), 1-9.

Nsabiyera, V., Ochwo-ssemakula M., and Sseruwagi P. (2012). Hot Pepper Reaction to Field Diseases. *African Crop Science Journal*, 20, 77-97.

Obeng-Ofori, D., Yirenkyi-Danquah, E., and Ofosu-Anim, J. (2007). Vegetable and Spice Crop Production in West Africa. Sam Woode Ltd.

Olawale, A., Balogun O. S., Akinyemi S. O., Solomon, and Kumar, P. L. (2015). Surveys of Virus Diseases on Pepper (Capsicum spp.) in South-west Nigeria. *African Journal of Biotechnology*, 14(48), 3198-3205.

Omotayo, A. M., Ribeiro, C., Oluleye, K., and Fajimi, A. (2012). Participatory evaluation of improved pepper (Caspicum Spp) among small scale farmers. Research Pre-proposal submitted to the Africa Brazil Agricultural innovation Marketplace Project, EMBRAPA Brazil.

UBRBDA (2020). Upper Benue River Basin Development Authority Yola. Annual report on Challenges of Agronomic Practices No 18. Adamawa Printing Press

Zaini, A., Siddik, M., and Rusdiansyah, A. (2020). Factors Affecting Farmer's Decision To Convert Pepper Garden Into Coal Mining Area. *Systematic Reviews in Pharmacy*, 11(6), 963-971.

Zakari, B. G., Ekong, N. J., and Tafida, M. A. (2016). In Vitro Effect of three Aqueous Plant Extracts on Fungi Associated with Post–Harvest Rot of Pepper (Capsicum Species L.) in Yola, Adamawa State, Nigeria. *FUW Trends in Science and Technology Journal*, 1(2), 406 – 409.