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Onion Bulb Rot Disease Affecting Yield of Women Producers in Rural Communities of the Gambia

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Abstract: The surge in onion bulb rot disease poses a significant threat to smallholder farmers who depend on onion cultivation as source of income. A survey was conducted on the prevalence of onion bulb rot disease affecting the yield of women producers in rural communities of the Gambia. The study was conducted in the six (6) agricultural regions where onion is massively cultivated. The objective of the research was to determine the level of spread and damage caused by the disease. The sampling method was purposive sampling based on observation and experience. In each region five (5) gardens and three (3) onion growers were selected with a total of 90 onion growers were interviewed. The result shows that 60% of respondents indicate symptoms of soft rot bulbs, leaf drops of 30% while 10% of the respondents indicate exudation of watery discharge from the root basal. The results shows that significant relationship ($p \geq 0.026$) between time of planting and percentage damage cause by the disease. In addition, correlation analysis was done showing a strong positive relationship ($r=0.9737$) between time of planting onions and disease incidence. The data was analyzed using SPSS software and the results were presented in frequencies and percentages. In conclusion all the vegetable gardens visited were infected by onion bulb rot disease except Jahuru Mandinka in CRR/North which results to best agronomic practices, quality seeds and best scheduling of water management. The findings recommend factors that enhances the spread of bulb rot disease in the gardens.

Keywords: Onion, women, yield, producers, disease, communities

INTRODUCTION

Onion bulb rot is a disease caused by various bacterial and fungi, such as *Botrytis Pseudomonas* and Fusarium leading to soft, discolored, and decaying bulbs that may have a foul odor (El, Naggar *et al;* 2023). Most onion diseases begin on plants growing in the field and continue to develop on the bulbs during storage and transit, when symptoms become evident. Effective control of post-harvest diseases begins with the understanding that these diseases originate in the field. Appropriate cultural practices, including crop rotations, removal of infected onion debris and culls, and proper cultivar selection, are essential for controlling onion diseases. (Belo *et al*; 2023). The government heavily depend on agriculture as a keystone of economic growth, create jobs, and generate incomes, for women and youths in the rural communities. However, the sector faces numerous challenges, including low productivity, which has implications for food insecurity, poverty reduction and overall economic growth. In this context, vegetable production, including onions, emerges as a vital component for diversifying agricultural output and enhancing food and nutritional

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security in the country (Joshi and Dama, 2024). Onion cultivation in particular holds significant importance in rural communities exceeding mere economic value to encompass cultural significance and nutritional benefits. It also acts as a hub for income generation, particularly for small-scale farmers, offering a reliable cash crop that can strengthens the financial stability of numerous families in The Gambia. Furthermore, apart from financial gains, onions support food and nutritional security. As a staple ingredient in local dish, they ensure a readily available and affordable source of nutrition, enriching the diets of consumers at rural communities. According to (WACOMP, 2023) onion consumption was estimated at 17,000 metric ton/year while 6,000 metric/ year was produced locally. Annual production and storage losses in onions as result of diseases can range from a trace to 50% or more depending upon the location, environment, and the causal agent involved (Chakraborty, *et al;* 2022). In recent years farmers have witnessed a concerning development: the emergence of onion bulb rot, locally known as 'Jabaa tolo.' This disease is characterized by soft rot of the bulb and has wreaked havoc on onion farms across the country, posing a significant threat to both production levels and livelihoods (Anjum, Vyas and Sofi, 2023) Most onion diseases begin on plants growing in the field and continue to develop on the bulbs during storage and transit, when symptoms become evident. Effective control of post-harvest diseases begins with the understanding that these diseases originate in the field. Appropriate cultural practices, including crop rotations, removal of infected onion debris and culls, and proper cultivar selection, are essential for controlling onion diseases (El-Ashry, 2022). Therefore, the objective of the research findings is to determine spread and damage caused by the disease in the major onion growing areas.

MATERIALS AND METHODS

Survey sites

The surveillance on onion bulb-rot disease was conducted in Six (6) Agricultural Regions from 22nd April to 28th June 2024.

Ethical approval

Ethical approval was obtained from the National Agriculture Research Institute under the Ministry of Agriculture, Livestock and Food Security before administering the questionnaire of the study.

Study area: The study was conducted in the six (6) agricultural regions of West Coast Region (WCR), North Bank Region (NBR), Lower River Region (LRR), Central River Region/south (CRR/S), Central River Region/ north (CRR/N) and Upper River Region (URR), where onion is massively cultivated respectively.

Sampling and data collection procedures

The sampling method was purposive sampling where five (5) gardens were selected each region. In each garden site, three onion growers were selected to serve as respondents, thus total of 90 onion growers were interviewed in the six agricultural regions. Table 1. shows the sampling frame of agricultural regions where onion is widely grown in the rural communities.

The onion bulb-rot disease was assessed through observation of incidence and damage level where the onions were growing at that time. Global Positioning System (GPS) was used to map out the coordinates of the various gardens to be able to identify the affected and non-affected areas of onion bulb-rot disease in the country. The interview method used was individual respondent to determine the area cultivated under onion, knowledge in identifying the disease, level of damage, practices used to control or prevent disease.

Table 1: Shows the selected gardens across the agricultural regions

#	*Agricultural Regions*	*No of Gardens*	*No of respondents*	*Total respondents*	*Actual respondents*
1.	West coast Region	5	3	15	90
2.	North Bank Region	5	3	15	
3.	Central River Region/N	5	3	15	
4.	Central River Region/S	5	3	15	
5.	Upper River Region	5	3	15	
6.	Lower River Region	5	3	15	

Informed consent

Onion production is clearly prominent in the rural communities particularly among the women folk of the Gambia. In the process of collecting data, the consents of the respondents/ participants were verbally agreed before the questionnaire was administered by women onion producers in the six (6) agricultural regions for trust and confidentiality.

Data analysis

The data were analyzed using SPSS software and descriptive statistics was used to analyzed the data in percentages represented in tables, figures, bar chart and graphs.

Farmers knowledge, perceptions and disease control practices: The interview method used was individual respondent where in each garden to determine the area cultivated under onion, knowledge in identifying the disease, level of damage, practices used to control or prevent disease.

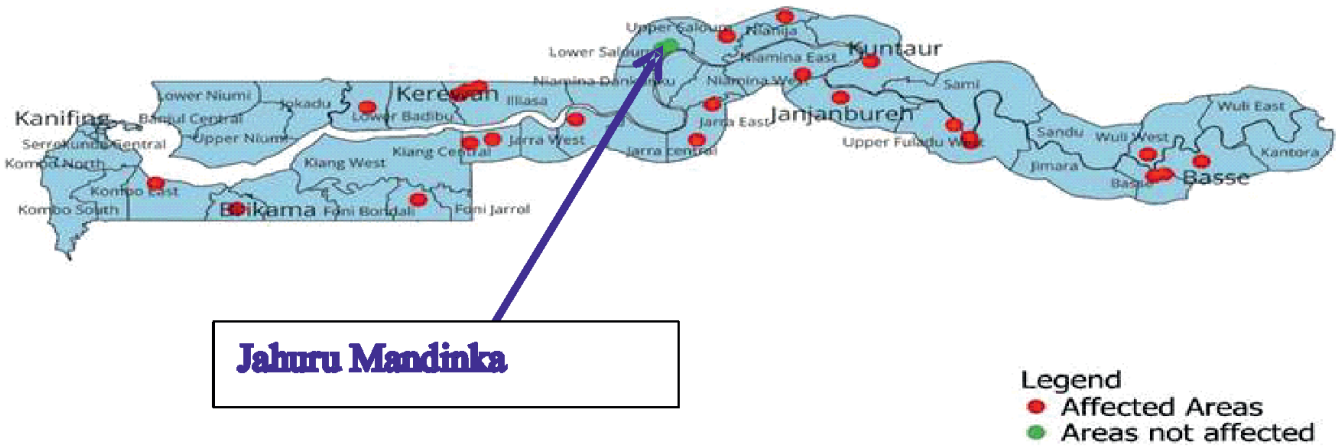

Figure 1: Shows the distribution of onion bulb rot disease in agricultural regions of 2024 vegetable season.

RESULTS AND DISCUSSION

Land area under onion production in the survey sites: The issue of land is sensitive and critical in the agricultural production and productivity. In terms of economic principles land is a factor of production meaningful that effective socioeconomic production cannot kick-start without access to arable and high soil fertility (WACOMP, 2023). The distribution of onion bulb rot disease in various regions of the country is presented in Figure 1. The result shows that onion bulb rot disease prevails in all the locations except in one location called Jahuru Mandinka in Central River Region/ North as spotted in green color. In addition, the results in Figure 2 presents the land area of the respondents under onion production in each region. The findings shows that North Bank Region (NBR) had the highest land area under onion production than all the other regions followed by URR, LRR, and CRRN. The West Coast Region was observed to have the lowest

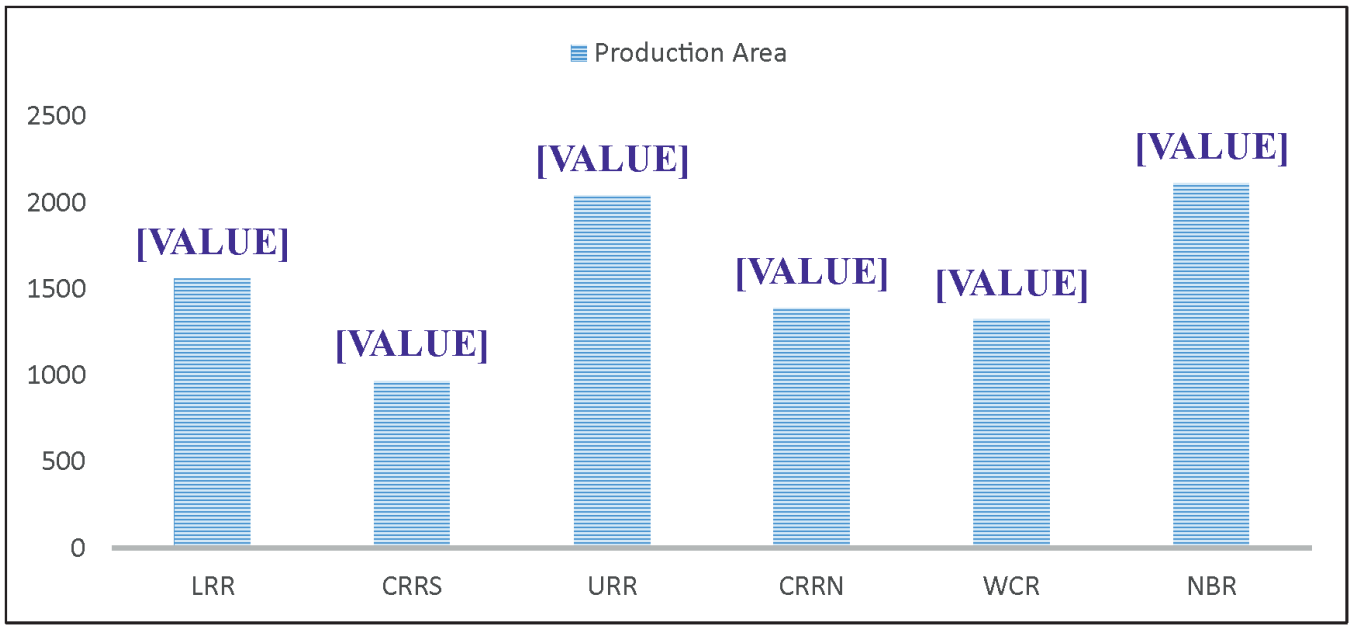

Figure 2: Shows production area/ha of onion.

land area under onion production. However, production or arable land decreasing due to salt intrusion in the low and upland fields.

The surge in onion bulb rot disease in The Gambia poses a significant threat to the agricultural sector, especially for smallholder farmers who depend on onion cultivation for their income. The exact cause of the disease remains unknown, making it difficult for farmers to manage, prevent and controlled the spread of diseases. The diseases affecting roots and stems of onion can significantly impact the yield, quality, quantity, and storage of onion bulbs due to incidence of pathogen in the soil, which is difficult to control (Zandamela *et al*; 2024). According to the majority of the farmers who said the disease could not be controlled, they have used different agrochemical in an attempt to control the disease, but these measures proved ineffective in eradicating the disease. The pathogen infects through the plant roots or the basal stem of onion, and symptoms are usually on the leaves because the onion plant was reduced to water and nutrient from the soils to the leaves (Tariq *et al;* 2022). Generally, from the respondent's field observation gives an account of description of onion bulb root disease. The symptoms indicate yellowing of leaves from the tip through the neck of onion bulb. From the results in Table 2 shows that 60% of respondents indicate disease symptom of soft rot bulbs with bad smell to leaf drop of 30% while 10% of the respondents indicate exudation of watery discharge from the root basal. According to (Ghimire, *et al;* 2022) onion basal rot is prevalent in the rainy season, while

Table 2: Shows symptoms of onion bulb rot disease in the regions

Regions	*Disease*	*Causes*	*Causative agent*	*Symptoms*	*Percentage (%)*
All the six onion producers	Onion bulb rot	Bacterial and fungal pathogens	*Fusarium oxysporum*	Yellow leaves	30
			Botrytis allii Sclerotinia cepivorum	Bulb rot and bad odour	60
			Enterobacter cloacae	Leaf drops and watery discharge	10

the incidence of the disease is higher during the dry season.

The issue of onion bulb rot disease can seriously affect the yield potential of onion while having negative income security of women vegetable producers in the rural communities (El Nahal et al; 2022). The results in Figure 4 shows the number of farmers affected by onion bulb rot disease in 2023/2024 production season. In 2024 production season the percentage of respondents affected by the onion rot disease was highest in North Bank Region and West Coast Region of 100% while lowest percentage of onion farmers affected by the onion bulb rot was found in Central River Region of 67% respectively. For last year (2023) onion production season, the highest percentage of farmers affected by the disease was observed in NBR (87%), LRR (73%) and URR (70%), respectively. On the effect of season on the incidence and severity of onion basal rot, it came to light that the incidence of the disease was significantly higher under rain-fed onion production conditions. the high incidence recorded in the rainy season might be ascribed to the favorable environmental conditions, particularly high soil moisture and humidity (Jaffar *et al;* 2023). The lowest percentage of farmers affected by the disease last season was recorded in CRRN (60%). In comparison the percentage of farmers affected by onion bulb rot disease in the two season, significant increase was 15% was observed in 2024 as compared to 2023 production season. This significant increase in the number of farmers affected by the disease may be attributed to some of the cultural practices done by onion growers that potentially favors the spread of the disease within the gardens (Sharma *et al;* 2024. The pathogenic bacteria are highly contagious and dispersal of the disease could be enhanced through many pathways such as use of contaminated tool/ equipment, contaminated hand, water splash, too much of water, exchange of contaminated seedlings (Malik. *et al;* 2024).

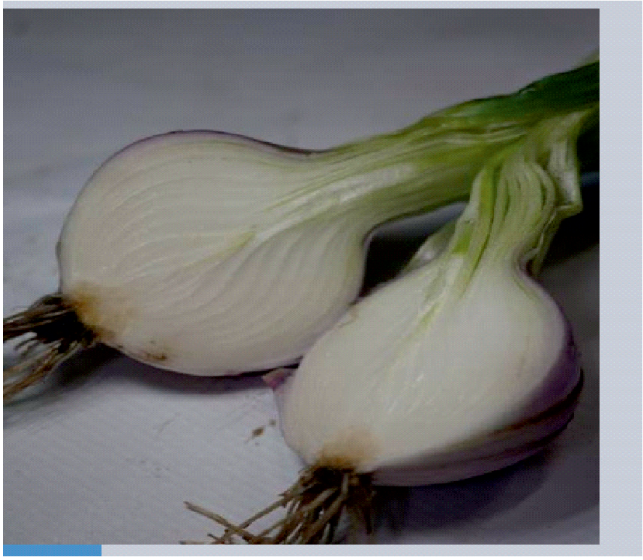

Figure 3: Shows white onion exudate

Figure 4: Shows severe onion rot infestation

The results in Figure 5 show the relationships of planting times undertaken by the respondents with the percentage damage observed as a result of soft bulb rot disease of onions. The results show significant relationship ($p \geq 0.026$) between time of planting and percentage damage cause by the disease. There is an indication from the results that, the time of transplanting of onion seedlings in the field delayed from October to January, results to high incidence of soft bulb rot disease (Mensah E, Oseik, and Danguah, 2024). Good irrigation management and cultural practices can limit the damage caused by onion bulb root disease (Sami, Elhakem, and Alharbi, 2021). Improper fertilizer application or mechanical damage

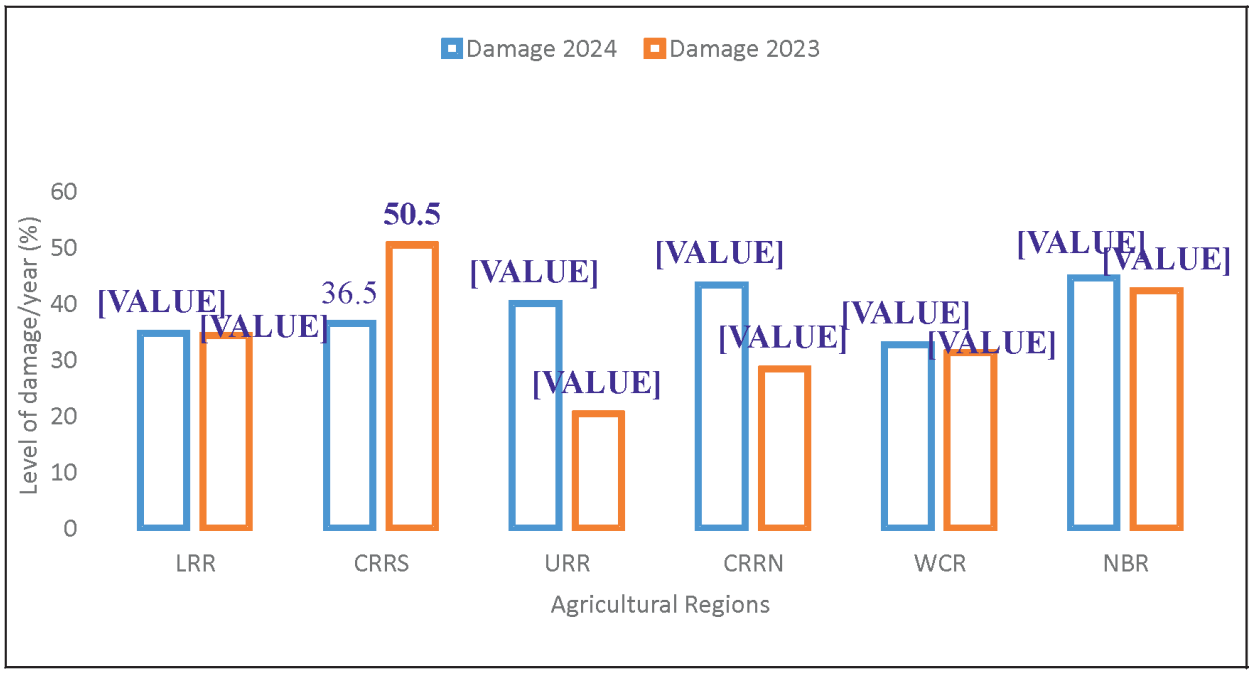

Figure 5: Shows the (%) damage caused by onion bulb rot disease

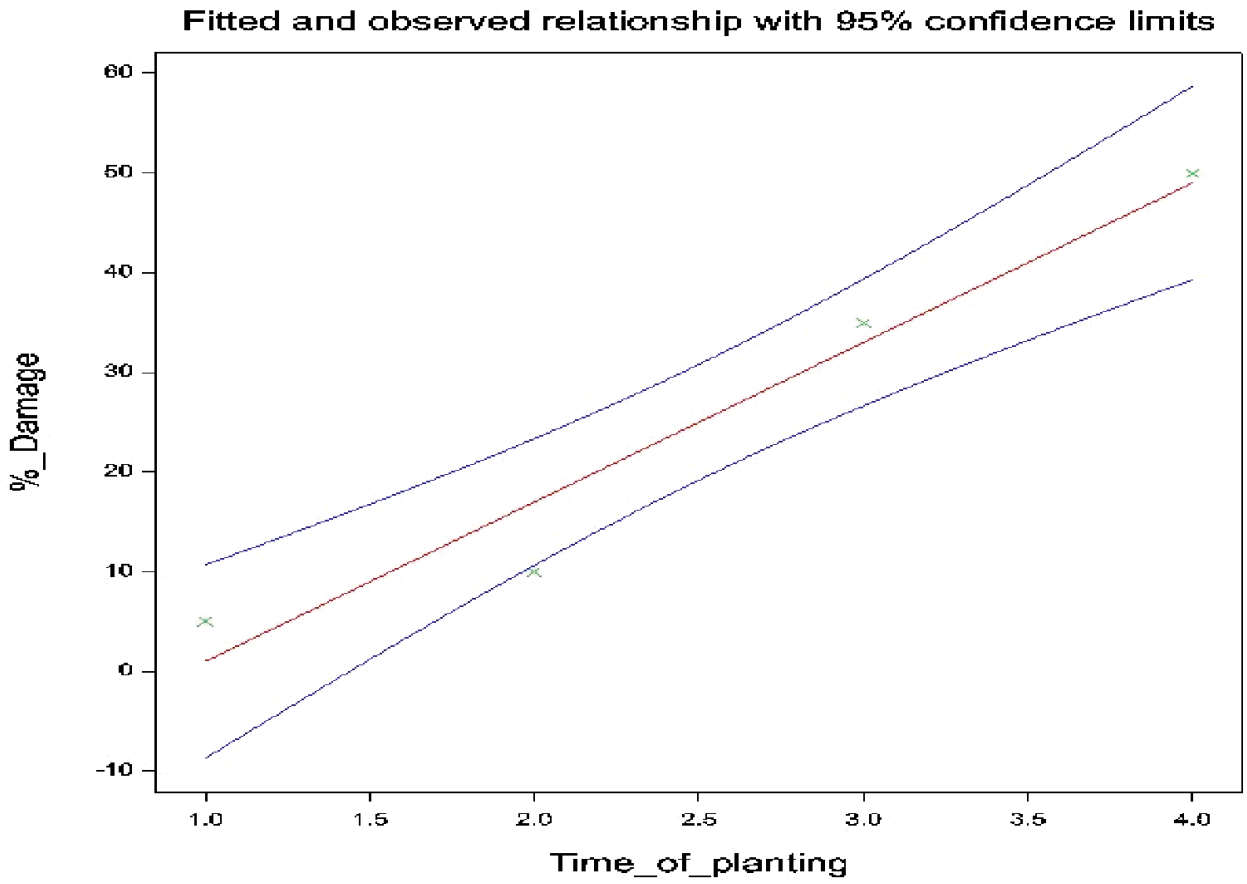

Figure 6: Shows relationship between (%) damage and time of planting.

during field operations can also predispose plants to infection. In addition, correlation analysis was done and the result showed a strong positive relationship (r=0.9737) between time of planting onions and disease incidence (Hegagy et al; 2024).

In vegetable production reliable and quality source of assorted seeds or seedling

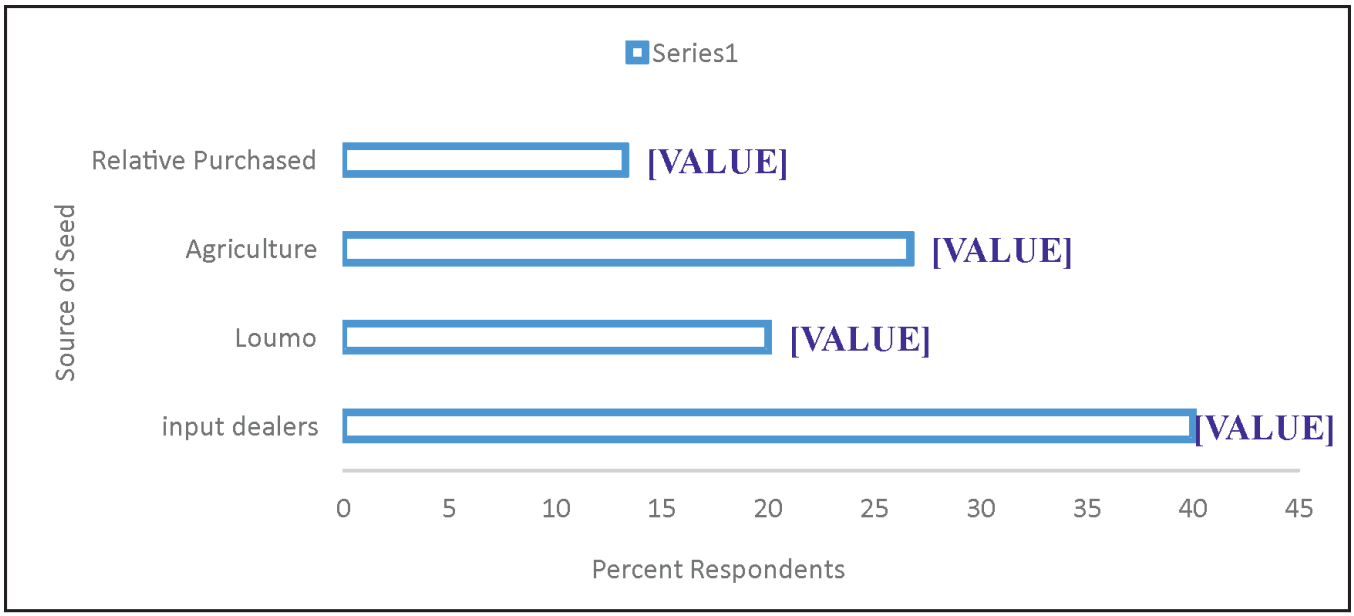

Figure 7: Shows the source of vegetable seeds.

is an integral part of obtaining better yields of onion. The sources of onion seeds by the respondents in the various agricultural regions are presented in Figure 7. The different sources of onion seeds outlined by the respondents were agricultural input dealers, weekly markets (Lumo), Department of Agriculture (DoA) and purchased by a relative as a gift. In figure 6, indicates that most of the respondents sourced their onion seeds from registered agricultural input dealers in the country of 40 % followed by seeds supplied by the projects within the Ministry of Agriculture, Livestock and Food Security (26.7%) and Lumo (weekly markets) (20%). The lowest seed source was purchased by relatives as gift (13.3%).

CONCLUSION AND RECOMMENDATIONS

The results of the research on onion bulb rot disease in the different agricultural regions showed that land area under onion production was highest in NBR and lowest in CRRS. The percentage of the respondents affected by the onion disease and the level of damage caused by the disease were also observed to be highest in NBR. Significant increase occurred in both the percentage of the respondents affected and the level of damage in the year (2024) as compared to last year (2023). The results revealed that the disease prevails in all the agricultural regions except one location which is Jahuru Mandinka in CRR/N. The respondents were able to describe the symptoms of the disease ranging from yellowing of the leaves, leaf falling and soft rot.

However, majority of the onion producers did not receive any training on the control and prevention of onion bulb rot disease. Moreover, the respondents were practicing various methods of control to help mitigate the impact of the disease in their gardens. The majority of the respondents grow their own onion seedlings in their gardens and few farmers purchased seedling from weekly markets and other farmers. Importantly, most of the respondents transplanted in December and January as a result the main cause of damage due to onion bulb rot disease. It highlights the importance of irrigation management during the most susceptible growth stage of bacterial infection and disease development in the production season.

Interestingly, production planning and careful timing of the final irrigation after the last leaf has emerged from the neck of onion

plants and shortly after the onset of tops to down, is recommended to limit losses to onion rot diseases without sacrificing marketable bulb yield. The correlation analysis showed a strong positive relationship between time of planting and disease incidence in the field. This indicates the time of planting onion pushed into January as rot disease increases in the field. In conclusion all the vegetable gardens visited were infected by bulb rot disease except one location in CRRN (Jahuru Mandinka) The farmers in NBR were found to be severely affected by the disease than the rest of the region and the WCR was less affected compared to the other regions. The disease incidence increased this season (2024) as compared to last season (2023). Therefore, this necessitates early planting of onions for significant reduction of onion bulb rot disease in the gardens further recommending research on the resistance/tolerance of different varieties to onion bulb rot diseases and other related infections associated to onion production and productivity.

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DECLARATION

Authors Contribution statement: The authors have immensely contributed in the preparation and drafting of the manuscript. The have read and agreed to published the correction of this manuscript. Conceptualization, Resource mobilization, and Supervision of the surveillance of the project.

Conflicts of interest: The authors registered declaration that there was no conflict of interest regarding to the publication of this manuscript.

Ethics approval: This study data was collected through the active participation of humans following the guiding principles of the research institute.

Consent for publication: All co-authors gave their consent to publish this paper in AAES.

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