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Study about the *Fusarium* disease infestation and its Impact on Cucurbitaceae Production in the Arid Region of Algeria.

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Abstract :

This study investigates the prevalence and impact of Fusarium disease on cucurbitaceous production in the arid region of Algeria, focusing specifically on the Biskra province. Cucurbit production holds significant economic importance in Algeria, with Biskra emerging as a leading producer in recent years. However, the escalating threat of Fusarium disease jeopardizes this vital sector.

A survey was conducted among 45 farmers across five regions of Biskra to assess the incidence and consequences of Fusarium wilt on crops such as cucumber, zucchini, melon, and watermelon. Results revealed Fusarium as the most frequently reported disease, affecting 51.2% of surveyed farmers, followed by oidium at 39% and downy mildew at 9.8%.

The study identified Uniforme as the predominant fungicide in use (44.44%), followed by Beltanol (31.11%) and Previcur (24.44%). Primary sources of Fusarium contamination were identified as soil and climate conditions (57.1%), followed by manure (24.3%) and infected seeds (10%). Common symptoms reported by farmers included wilting (34.3%), yellowing (32.4%), and vascular browning (28.6%).

Various control methods were employed, including cultural techniques, fungicides, resistant varieties, crop rotation, soil amendments, and solarization. The findings underscore the urgency of implementing effective control strategies to mitigate Fusarium disease's detrimental effects and ensure the long-term sustainability of cucurbit production in the Biskra region.

This research contributes valuable data on Fusarium prevalence and impact in Biskra, facilitating the formulation of targeted disease management protocols crucial for safeguarding agricultural productivity and enhancing food security in the arid regions of Algeria.

Key words : Cucurbitaceous, Fusarium Disease, Control Methods Arid Region ,Algeria ,

1.Introduction

Cultivating cucurbits, such as zucchini, melon, watermelon and cucumber, is of significant economic importance, especially in arid places worldwide. Their cultivation is prevalent in numerous nations globally(Blancard et al., 1991; Christenhusz& Byng, 2016). Cultivation of cucurbits is of significant importance in Algeria, with a national production of 3,565,428.83 tonnes in 2020 and a cultivated area exceeding 7,000 hectares. Specifically, this agricultural product has shown significant growth in the wilaya of Biskra in recent years. In 2010, the cucurbit production in Algeria covered an area of 181.000 hectares and produced an estimated 132,162 quintals. By 2020, the production area is expected to expand to over 2,925 hectares, with a production rate of 143,540 quintals. As a result, it will become the leading producer of cucurbits in Algeria, according to MADR (2020). These statistics provide evidence of the significant economic value of this crop in both Algeria and Biskra.

The Biskra region, also known as the Ziban, is situated in the Saharan climatic zone. This area is characterised by infrequent and minimal rainfall, elevated temperatures, strong luminosity, and high evaporation rates (Chehma, 2011) . The southern part of the region has gypsiferous and salty soils, while the eastern area features fertile alluvial clay soils. The northern section has less developed and less fertile soils, whereas the north-western part has sodic clay soils (Boucetta, 2018). The climatic conditions in the region allow for the cultivation of many crops through irrigation, particularly cucurbits (Merdaci, 2020).

Cultivating cucurbits is susceptible to multiple fungal infections, such as *Fusarium spp*(Blancard et al., 1991; Gauthier & Munir, 2023; Pfeufer, 2021). Fusarium species are commonly found in soils throughout different climatic regions worldwide (Summerell, 2019). Fungi form a mycelium in the soil and infect plants through damaged roots (Asssohoun et al., 2016), leading to symptoms such as wilting, yellowing, drying, and root decay. These fungal infections inflict significant harm and provide a significant economic (Booth, 1971; Zitter, 1998). Fusarium species have the ability to produce and store several harmful secondary metabolites called mycotoxins in plants and processed products, which poses a safety concern (Summerell& Leslie, 2011).

Our survey aims to investigate the prevalence of fusarium disease illness in cucurbits in the Biskra region, focusing on the extent of damage caused and the effectiveness of control strategies. This study will enable us to establish control techniques to combat this perilous disease.

2.Material and methods Study area:

The Biskra Province accounts for almost 32% of the national production of horticultural crops, making it the leading producer of early vegetables in Algeria (Rekibi, 2015). Cucurbits are among the most cultivated vegetables. For this reason, this study was conducted in this region. The study area is located in the eastern part of the Zeeb region in Biskra. The elevation above sea level is 112 m, making it one of the lowest cities (Nourani&bdelali, 2019). The provincial capital is about 400 kilometers away from the capital, Algiers. Its area is 21671 km², divided into 12 Daïra (Fig. 1). Biskra has a hot and desert climate, characterized by very hot and dry summers and mild winters, with average annual precipitation ranging from 120 to 150 mm per year. The average annual temperature is 20.9°C.

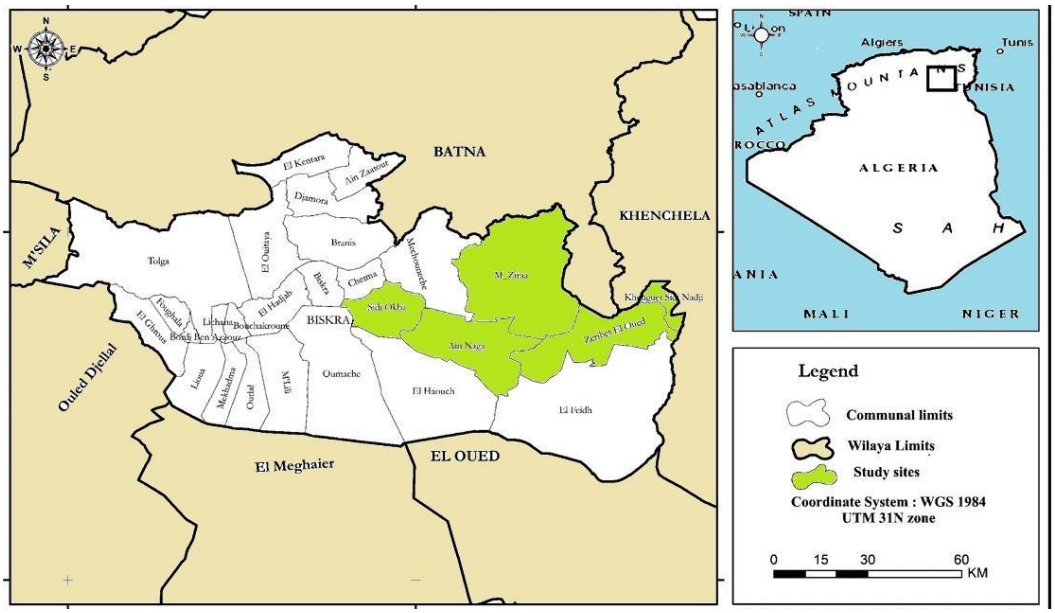

Fig 1.Study area

Survey

A survey was carried out in the wilaya of Biskra during the 2021-2022 season. The study employed face-to-face interviews, utilizing questionnaires, to gather data from farmers cultivating cucurbits, including cucumber, zucchini, melon, and watermelon. The objective of our survey was to ascertain the magnitude of the harm inflicted by fusarium wilt on these crops. Information was gathered from a total of 45 highly efficient farmers who are located in five different locations of the Biskra wilaya. These regions include M'ziraa, Ain naga, Sidi Okba, Zribet El Oued, and Khenget-sidi-nadji (as shown in table 1).

Table 1. Number of people surveyed by region.

Region	M'ziraa	Ain Naga	Sidi Okba	Zribet El Oued	Khenget-sidi-nadji
Number of farmers	14	13	10	6	2

Collection of data and subsequent statistical analysis

The data collected encompassed both quantitative and qualitative information pertaining to the following topics:

- The diverse fungal infections that impact cucurbits.
- The detrimental effects and reduction in crop output caused by Fusarium wilt disease, including its symptoms and methods of management, as well as the broad-spectrum chemical products employed by cucurbit growers.
- The identification of the active components was conducted by referencing the trade names of pesticides listed in the index of plant protection products for agricultural use (DPVCT, 2015 and 2017), as well as the classification provided by the World Health Organization (WHO) in 2005 and the International Union of Pure and Applied Chemistry (IUPAC) database of plant protection products in 2020.The obtained data undergoes processing, coding and entry for statistical analysis utilizing Excel 2019 and IBM SPSS (Social Package For Social Sciences) Version 25.

3.Results and interpretation

The data was collected from 65 greenhouse producers in the wilaya of Biskra. The average size of farms is approximately 2.1 ha and varies from 0.25 to 12.75 ha. All greenhouses studied were tunnels and Canary Islands . The data also showed that almost all of the area covered by a greenhouse was drip irrigated and that approximately 73% of the farms visited were privately owned and 27% were rented.

Diseases :

Our study indicates that there are variable levels of occurrence for many plant diseases, including Fusarium, Oidium and Mildiou, (Fig.2) . Fusarium is the most often reported ailment among the responders, with a prevalence rate of 51.2%. This signifies a high prevalence of Fusarium infection in the agricultural regions that were examined. On the other hand, Oidium, while common, has a lower occurrence rate of 39.0%. This indicates a

significant occurrence of Oidium, albeit it is less prominent in comparison to Fusarium. Conversely, mildew seems to have the lowest frequency compared to the other two disorders, as just 9.8% of participants reported experiencing it. The relatively lower occurrence rate suggests that Mildiou has a less effect on our study area.

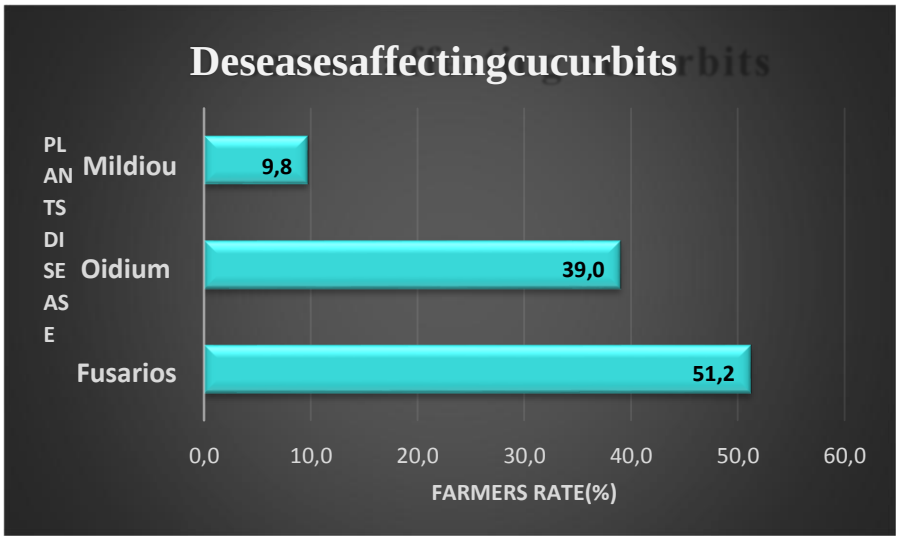

Fig. 2 Deseases affecting cucurbits

Chemical products

The study of agricultural goods used for disease control shows how active components are distributed among questioned farmers in their efforts to prevent Fusarium infection in the arid regions of Algeria. Out of the participants, Uniform is the most frequently used product, accounting for 44.44% of the treatments reported. This indicates a widespread dependence on Uniform, suggesting that it is seen as effective or easily accessible across the agricultural community. Beltanol, which contains Mefenoxam and Azoxystrobine as its active components, accounts for 31.11% of the reported therapies. This demonstrates a significant use of Beltanol, emphasizing the use of alternative active substances for the purpose of controlling Fusarium. Furthermore, Previcur, which contains Propamocarb as its active component, accounts for 24.44% of the therapies that have been recorded. The prevalence of Previcur among farmers in the dry agricultural environments of Algeria indicates its effectiveness or appropriateness for managing Fusarium (Fig.3).

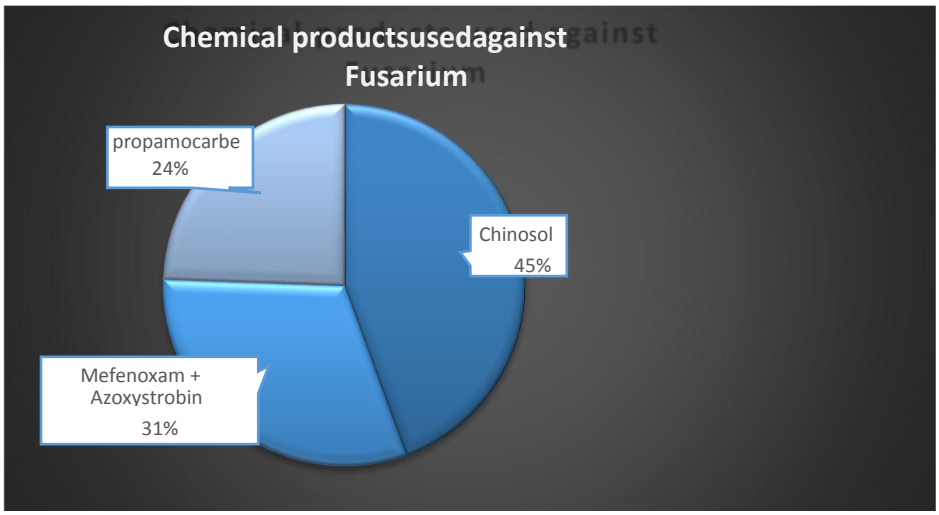

Fig. 3 Chemical products used

Contamination sources

The examination of the origins of Fusarium contamination provides insight into the many methods in which this plant disease spreads throughout the agricultural ecosystems of dry regions in Algeria. The key variables contributing to Fusarium contamination, as reported by 57.1% of respondents, are the soil and climatic conditions. This emphasizes the importance of comprehending the interaction between soil parameters and climate factors in influencing the frequency and dissemination of Fusarium.

In addition, fumier, often known as manure, is recognized as another significant cause of contamination, contributing to 24.3% of the recorded instances. The incorporation of manure as a source highlights the possible involvement of organic amendments in the spread of Fusarium and stresses the significance of implementing appropriate management techniques to reduce the risks of contamination associated with agricultural inputs.

Furthermore, the utilization of tainted seeds is recognized as a notable origin of Fusarium infection, accounting for 10.0% of documented instances. The importance of seed quality and hygiene procedures in reducing Fusarium outbreaks is emphasized, emphasizing the necessity for strict seed selection and treatment regimens.

In addition, a lesser proportion of participants indicate various sources (5.7%) and illnesses during the nursery stage (2.9%) as factors contributing to Fusarium contamination. (Fig.4).

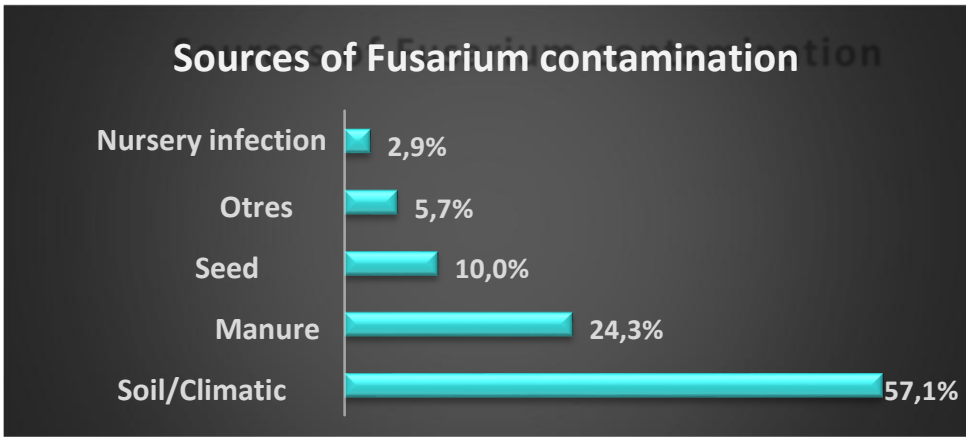

Fig. 4 Sources of Fusarium contamination

Method of wrestling

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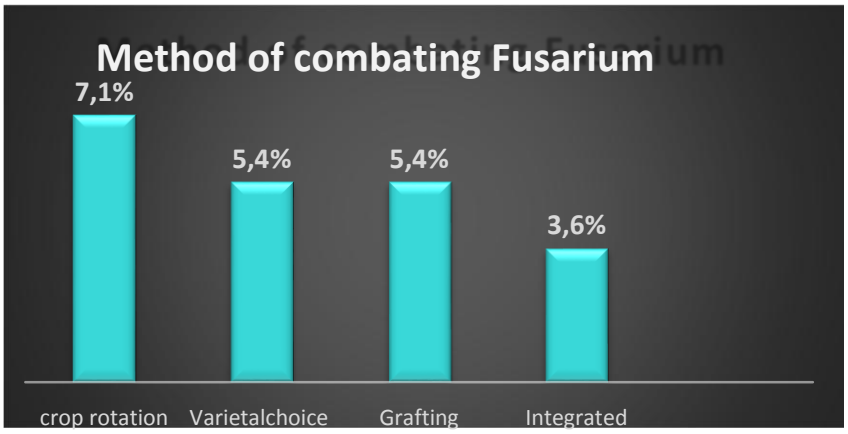

Fig 5 .Method of combating Fusarium

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Disease symptoms

The manifestation of Fusarium infection presents a spectrum of symptoms that affect the overall health and productivity of cultivated crops in the arid regions of Algeria. Among these symptoms, wilting stands out as the most commonly reported, with 34.3% of respondents identifying it as a prevalent indicator of Fusarium infection. Wilting, characterized by the drooping and desiccation of plant tissues, signifies the disruption of water and nutrient uptake due to Fusarium-induced vascular damage, resulting in diminished plant vigor and productivity.

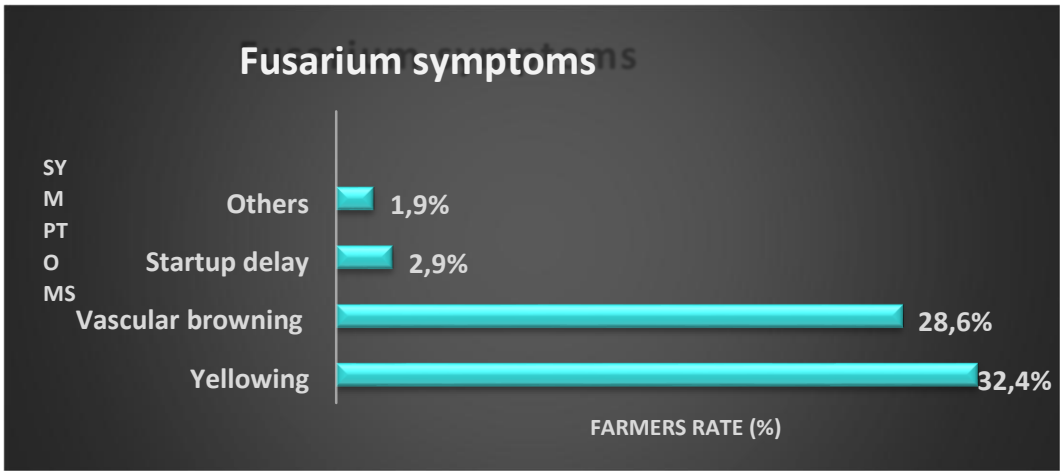

Fig. 6 Fusarium symptoms

Additionally, yellowing of foliage is reported by 32.4% of respondents as a prominent symptoms of Fusarium infection. This symptom, indicative of chlorosis and nutrient deficiency, reflects the impairment of photosynthetic processes and nutrient assimilation caused by Fusarium colonization, leading to diminished plant growth and vigor (Fig.6).

Furthermore, vascular browning is identified by 28.6% of respondents as a characteristic sign of Fusarium infection. Vascular browning, resulting from the deposition of phenolic compounds and the obstruction of nutrient flow within plant vascular tissues, signifies the systemic spread of Fusarium pathogens and the progressive deterioration of plant health.

Moreover, a small percentage of respondents report symptoms such as delayed growth initiation (2.9%) and other miscellaneous indicators (1.9%) associated with Fusarium infection. These additional symptoms may include stunted growth, necrotic lesions, or abnormal development patterns, reflecting the diverse manifestations of Fusarium-induced stress on plant physiology and morphology.

Overall, the identification and recognition of Fusarium symptoms provide valuable insights into the diagnosis and management of Fusarium disease in agricultural systems, enabling farmers to implement timely and targeted interventions to mitigate its impact on crop health and productivity(Fig.6).

Fusarium is a fungal disease caused by a diverse range of fungi that impacts numerous plants, both in the garden and in the vegetable patch. Initial indications comprises of drooping stems, discolored patches on leaves, and decay of the root system.

Gauthier & Munir (2023) conducted a study which found that fruit diseases affecting cucurbits such as cucumber, melon, pumpkin, summer squash, winter squash, and watermelon can result in complete loss of crop production in both commercial fields and household plantings. Fusarium illnesses are prominent ailments that impact cucurbits, while separate publications address other diseases such downy mildew and powdery mildew.

Vegetable crops affected by Fusarium exhibit signs such as plant wilting, yellowing of older leaves, staining of vascular tissues, and maceration of cortical parenchyma. The symptoms are a result of the Fusarium oxysporum infection. To mitigate fusariosis, several proactive interventions can be implemented. These strategies encompass the utilization of cultivars that are resistant to the pathogen, rotating crops, adding amendments to adjust soil pH, and employing soil solarization to deactivate the pathogen. Blancard et al. (1991) propose the utilization of sulfur-based fungicides, specifically Mancozeb and Maneb, along with implementing effective cultural techniques to manage this disease.

Fusariosis is more likely to occur when certain conditions are present. These conditions include high humidity or rainy periods during cereal flowering, with rainfall of approximately

40 mm significantly increasing the risk. The disease also thrives in the presence of contaminated crop residues in the soil and warm temperatures, particularly around 25°C. It does not develop well below 15°C or above 35°C. Additionally, light, acid soil, damage to bulbs and cloves, and any stress to the plant can contribute to the development of the disease. Lastly, the disease can be transmitted through contaminated seeds.

Fusariosis is primarily influenced by three key factors: high humidity during the flowering period, the existence of inoculum in the soil, and elevated temperatures. Effective management measures are crucial for mitigating the danger of Fusarium head blight and safeguarding vegetable crops against this disease.

4.Conclusion

The findings of this study offer a solid foundation for the creation of efficient measures to combat fusarium wilt of cucurbits in the Biskra region. By implementing these preventative measures and employing suitable management strategies, farmers and producers in the area can decrease the occurrence of the illness and alleviate the resulting financial losses. These results are crucial for the long-term growth of agriculture in the region and can be used as a benchmark for other places dealing with similar issues of fusarium wilt in cucurbits.

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