Süleyman Demirel Üniversitesi
Fen Bilimleri Enstitüsü Dergisi
Cilt 26, Sayı 3, 372-376, 2022

Süleyman Demirel University
Journal of Natural and Applied Sciences
Volume 26, Issue 3, 372-376, 2022

DOI: 10.19113/sdufenbed.1057277

Prevalence of Fungal Disease Agents in Garlic Growing Areas of Gaziantep Province

Nuran YILDIZBAKAN[1], Aydın ATAKAN*[2], Hülya ÖZGÖNEN ÖZKAYA[1]

[1]Isparta University of Applied Science, Faculty of Agricultural, Department of Plant Protection, 32200, Isparta, Türkiye

[2]Gaziantep University, Araban Vocational School, Department of Plant and Animal Production, 27650, Gaziantep, Türkiye

(Alınış / Received: 13.01.2022, Kabul / Accepted: 31.03.2022, Online Yayınlanma / Published Online: 20.12.2022)

Keywords
Garlic,
Fungal disease,
Prevalence,
Gaziantep

Abstract: Surveys were carried out in garlic cultivation areas of Gaziantep province in April 2018 and April 2019 to determine the prevalence of fungal diseases of garlic. After the isolation process was conducted according to routine mycological methods, fungi were identified according to their cultural and morphological characteristics. Fungi belonging to genera of *Fusarium, Rhizoctonia, Macrophomina* and *Puccinia* were determined in garlic production areas. The most prevalent genus among all fungi was determined as the *Fusarium* isolated from all areas. The rust disease caused by *Puccinia porri* has not been detected in the Islahiye district and its prevalence in other areas varies between 5,1-18 %.

Gaziantep İli Sarımsak Yetiştirme Alanlarında Fungal Hastalık Etmenlerinin Yaygınlıkları

Anahtar Kelimeler
Sarımsak,
Fungal hastalık,
Yaygınlık,
Gaziantep

Öz: Gaziantep ili sarımsak ekiliş alanlarında görülen fungal hastalıkların yaygınlıklarının belirlenmesi amacıyla 2018 ve 2019 yıllarının Nisan aylarında surveyler yapılmıştır. Mikolojik yöntemlere göre yapılan fungal izolasyon işlemine göre funguslar, kültürel ve morfolojik özelliklerine göre tanımlanmıştır. Sarımsak üretim alanlarında *Fusarium*, *Rhizoctonia, Macrophomina* ve *Puccinia* cinslerine ait türler belirlenmiştir. Tüm funguslar içerisinde en yaygın cins, *Fusarium* olarak belirlenmiştir. *Puccinia porri* tarafından sebep olunan pas hastalığı Islahiye de tespit edilememiştir ve diğer alanlardaki yaygınlığı %5,1-18 arasında değişmektedir.

1. Introduction

Garlic (*Allium sativum* L.), one of the members of the Alliaceae family and first cultivated *Allium* species, is a bulbous plant [1, 2]. There are two subspecies of garlic, which is known to have almost 600 varieties [3]. One of these species is *A. sativum* var. *ophioscorodon,* the other one *A. sativum var. sativum* is cultivated widely and economically important in Turkiye. Garlic, which has an important role in terms of agricultural and human health benefits, is widely grown in Mediterranean countries, India, China, the Far East and the USA [4].

Garlic is a plant that likes mild climates as well as being a long-day plant. It can be grown easily in climates where the average temperature is above 15-20 °C. As the temperature increases, problems occur in the development of garlic and plant growth rate reduce. Bulbs that grows below the ground can protect themselves against cold damage up to -10 °C [5].

In 2018, the garlic growing areas and production in Turkiye were reported as 15.000 hectares, over 140.000 tonnes. Although Kastamonu was the first province to be remembered for its garlic production, Kastamonu province replaced with Gaziantep based on garlic production amount in 2018. Gaziantep has a considerable role in the total area with its production area of 21.516 decares. In terms of dry garlic production, Kahramanmaraş (13.47%) follows Kastamonu (17.45%) and Gaziantep (17.61%) provinces [6].

Plant protection problems occur frequently in agricultural areas and from these, fungal plant diseases are responsible for seriously yield losses in production processes [7, 8]. Fungal diseases lead to

* Corresponding author: aydinatakan@gantep.edu.tr

economic losses in garlic and onion production areas. Plants belonging to the genus *Allium*, such as onions and garlic, are affected by certain soil borne plant pathogens such as *Fusarium* spp., *Rhizoctonia* spp., *Pythium* spp., *Sclerotium* spp., *Sclerotinia sclerotiorum*, and *Macrophomina phaseolina*. These pathogens cause significant losses in the quality and yield of agricultural products all over the world [9, 10]. In a study on onion production areas in seven provinces of Turkiye in 2007, samplings were performed in 223 fields, and 332 isolates belonging to 7 *Fusarium* spp. were obtained. The isolates were identified as *F. oxysporum*, *F. solani*, *F. acuminatum*, *F. equiseti*, *F. proliferatum*, *F. redolens*, and *F. culmorum* based on morphological and cultural characteristics [11]. In the other study conducted by Türkkan and Karaca [12], fungal root-rot agents associated with onion fields in Amasya province and their incidence and severity were investigated. Moreover, some studies have been conducted on fungal causal agents in garlic and onion cultivation areas in North America and Serbia [13, 14]. As a result of the literature review on the losses caused by fungal disease agents in the garlic growing areas of Gaziantep Province, study has not been found.

In this study, it was aimed to guide future studies by determining the fungal disease agents and prevalence in the garlic cultivation areas of Gaziantep Province.

2. Material and Method

2.1. Survey study

According to 2017 data of Gaziantep Provincial Directorate of Agriculture, random sampling was performed in garlic production areas in April of 2018 and 2019. The surveying areas were indicated in Figure 1.

Figure 1. Garlic cultivation areas and sampled districts in Gaziantep Province

Survey areas were randomly selected in Gaziantep. Diseased plants were collected according to the randomized sampling method [15]. The collected samples were kept in plastic bags and taken to the laboratory, and then subjected to isolation procedures.

Some information about garlic cultivation and sampled areas in Gaziantep Province is given in Table 1.

Table 1. Garlic growing areas and sampling data in Gaziantep province

	Cultivation area (da)	Sampled area (da)	Sampled fields	Collected plants
Araban	1200	145	7	70
Sahinbey	500	54	3	30
Oguzeli	3615	361	18	180
Nurdagı	1500	152	8	80
Sehitkamil	900	94	5	50
Islahiye	50	10	1	10
Total	7765	816	42	420

2.2. Isolation of the fungal disease agents

For the isolation process, the roots and stem of affected plants were washed thoroughly under tap water and dried. The infected tissues were cut into small pieces (approximately 4-5 mm length) from the plant parts containing both symptomatic and asymptomatic tissues. All pieces were surface-sterilized in 2% sodium hypochlorite (NaOCl) solution for 3 minutes and washed twice in sterile distilled water and dried again. Afterwards, sterilized tissues were plated on a potato dextrose agar (PDA) medium. After incubation of the Petri dishes for 7 days at 25 °C in the dark, colonies growing from the tissue were transferred to fresh Petri plates.

2.3. Identification of fungal disease agents

Species were identified by preparing a slide culture separately for each isolate [16]. *Fusarium* spp. was identified according to The *Fusarium* Laboratory Manual published by Leslie and Summerell [17]. After 10 days of incubation at 25 °C in the dark, the isolates were identified considering its morphological characteristics including hyphal branching, phialides, microconidia, macroconidia shapes and sizes, chlamydospore and sporodochium formation. *Rhizoctonia* spp. was identified according to the characteristic features of vegetative hyphae [18], the number of nuclei in the cells [19], colony colour and characteristics in the PDA medium [20]. *Macrophomina* and *Puccinia* species were identified with reference to Ashby [21] and Goidanich [22] and *Puccinia* to Laundon and Waterson [23] and Koike [24].

2.4. Determination of prevalence of the fungal disease agents

The disease rates (%) were determined by proportioning the plants showing the characteristic symptoms of the disease to the total number of plants in each garlic field. After determining the disease rates for each cultivation area, the prevalence rates of district were calculated [15].

3. Results

In the result of the surveys carried out in the garlic production areas of Gaziantep province in 2018 and 2019, the prevalence (%) of fungi were indicated in Table 2.

The prevalence of *Fusarium* was the highest in garlic production areas of Gaziantep. The genus *Fusarium* exhibited different rates of prevalence (52.0-67.4%) in all fields surveyed.

The genus *Macrophomina* could not be determined in Sehitkamil and Oguzeli districts which have the highest garlic production area. Besides, it was determined that the *Rhizoctonia* genus showed varying rates (8-24%) in all survey areas, except Sehitkamil. The prevalence of the other group, including the genera *Rhizopus, Sordaria, Aspergillus* and *Trichoderma* varied between 6.6% and 38.4% (Table 2).

As a result of the diagnostic studies, a total of 8 species, 6 of which belong to the *Fusarium* genus, were identified. The areas where the identified species are isolated and their frequencies of isolation (%) are presented in Table 3.

As can be seen from Table 3, *F. oxysporum* and *F. poae* were isolated from all fields surveyed. *F. sporotrichioides* was only isolated from Sehitkamil and its prevalence was 11.4%. Other soilborne pathogens obtained and identified in garlic growing areas were *R. solani* and *M. phaseolina*.

These results show that *Fusarium* species have a wide range of prevalence in garlic cultivation areas. Onion-garlic rust disease pathogen *P. porri* was detected in all cultivation areas except Islahiye. The disease and prevalence rate of garlic rust in garlic cultivation areas are presented in Table 4. Its disease rate was determined to be 14% in Gaziantep province.

4. Discussion and Conclusion

Pathogens attack *Allium* species throughout their production periods. Garlic is vegetatively propagated by planting its cloves [25]. In this case, especially soil-borne pathogens invade the vegetative materials and easily cause diseases in the next cultivation period. It is well known that pathogens such as *Fusarium* spp., *Rhizoctonia* spp., *Pythium* spp., *Sclerotium* spp., *S. sclerotiorum*, and *M. phaseolina* cause diseases in onion and garlic production areas. In addition, it causes decreases in product quality and yields worldwide [9]. *F. proliferatum* is the most common fungal pathogen in garlic and onion cultivation areas in Serbia. Although *F. oxysporum*, *F. solani*, *F. acuminatum* and *F. equiseti* were other species isolated and identified in Serbia by Stankovic [12], the prevalence of these species was reported to be less than the *F. proliferatum*. In a study conducted in onion cultivation areas of Bursa, Ankara, Eskişehir, Yozgat,

Table 2. The prevalence of the genera isolated from the garlic growing areas (%)

	Prevalence (%)			
	Fusarium spp.	*Rhizoctonia* sp.	*Macrophomina* sp.	Other
Araban	52.0	24.0	9.4	14.6
Sahinbey	48.0	24.0	6.7	20.7
Oguzeli	67.4	26.0	-	6.6
Nurdagı	54.0	21.0	5.3	19.8
Sehitkamil	61.6	-	-	38.4
Islahiye	56.0	8.0	2.0	34.0

Table 3. Species obtained from garlic fields surveyed and frequency of isolation (%)

	Isolation frequency (%)					
	Araban	Sahinbey	Oguzeli	Nurdagı	Sehitkamil	Islahiye
F. oxysporum	20.4	20.1	24.3	31.7	23.1	39.8
F. poae	20.7	13.6	18.7	20.8	13.9	16.2
F. sporotrichioides	-	-	-	-	11.4	-
F. semitectum	7.4	5.6	3.9	1.5	2.7	-
F. verticillioides	3.5	3.0	20.5	-	6.0	-
F. proliferatum	-	6.4	-	-	4.5	-
R. solani	24.0	24.0	26.0	21.0	-	8.0
M. phaseolina	9.4	6.7	-	5.3	-	2.0

Table 4. The prevalence of garlic rust in garlic growing fields in Gaziantep.

	Disease incidence (%)	Prevalence (%)
Araban	13.7	7.1
Sahinbey	12.0	3.0
Oguzeli	17.8	18.0
Nurdagı	9.8	8.2
Sehitkamil	9.2	5.1
Islahiye	-	-

Çorum, Tokat and Amasya provinces, *F. oxysporum* was determined as the most common species among all *Fusarium* species with a rate of 66.57%. In this study, it was also determined that *F. culmorum* was the species with the lowest prevalence with a rate of 0.9%. [11]. Our results are in parallel with the other studies.

Rust, caused by *P. porri* in *Allium* species occurs in most of the World and the severity of rust diseases varies among crops and localities [9]. Severe diseases can decrease bulb weight by up to 60% with quality loss [26]. In a study conducted in Cuba, according to the data obtained by surveys from garlic production areas, it was reported that *P. porri* caused diseases on the onion leaves and rust infection also brought about a yield loss of up to 51% in garlic cultivation areas [24]. In previous studies, it was reported that garlic rust causes serious problems all over the world [27-29].

Garlic cultivation is very important for Gaziantep and Turkiye. As a result of this study, the prevalence and isolation frequency of fungi were determined in the garlic cultivation areas of Gaziantep. The negative effects of fungal diseases on yield and quality constantly poses a serious problem in garlic cultivation. Although much research has been performed in different garlic and onion cultivation areas of Turkiye, no research has been conducted in Gaziantep. For this reason, it is important to determine garlic fungal diseases and its prevalence in this province.

According to the results obtained from this study, it is understood that the range of fungal agents occurring in garlic production is quite common. Therefore, this study constitutes the basis of many future studies.

Declaration of Ethical Code

In this study, we undertake that all the rules required to be followed within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with, and that none of the actions stated under the heading "Actions Against Scientific Research and Publication Ethics" are not carried out.

References

[1] Llamas, P., Paton, G., Diaz, G., Serna, G., Saez, B. 2013. The Effects of Storage Duration, Temperature and Cultivar on the Severity of Garlic Clove Rot Caused by *Fusarium proliferatum*. Postharvest Biology Technology, 78, 34-39.

[2] Ipek, M., Ipek, A., Simon, P. W. 2008. Molecular Characterization of Kastamonu Garlic: An Economically Important Garlic Clone in Turkey. Scientia Horticulturae, 115(2), 203-208.

[3] Kamenetsky, R., London Shafir, I., Khassanov, F., 2005. Diversity in Fertility Potential and Organo-sulphur Compounds Among Garlics from Central Asia. Biodivers Conserv, 14(2), 281–295.

[4] Heinrich, P.K., Larry, D.L. 1996. The Science and Therapeutic Application of *Allium sativum* L. and Related Species. Williams & Willkins, USA, 329 pp.

[5] Baytop, T. 1999. Türkiye'de Bitkilerle Tedavi Geçmişte ve Bugün. Nobel Tıp Kitabevi, İstanbul, 480 pp.

[6] TUIK, 2018. Turkish Statistical Institute. www.tüik.gov.tr (Erişim Tarihi: 21.12.2019).

[7] Atakan, A., Ozgonen Ozkaya, H. 2018. Antalya İli Karanfil Seralarında Toprak Kökenli Fungal Hastalık Etmenlerinin Yaygınlığının Belirlenmesi. Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 22(1), 216-220.

[8] Atakan, A., Erdoğan, O., Ozgonen Ozkaya, H. 2020. Evaluation of Plant Protection Practices of Garlic Growers in Gaziantep Province. Turkish Journal of Agriculture - Food Science and Technology, 8(9), 1942-1947.

[9] Schwartz, H.F., Mohan, S.K. 1995. Compendium of Onion and Garlic Diseases. APS Press, USA, 54 pp.

[10] Bayraktar, H., Tekin, K., Özer, G. 2014. Soğan Üretimi ile İlişkili Farklı *Fusarium* Türlerinin PCR-RFLP Analizi. Anadolu Tarım Bilimleri Dergisi, 29(3), 194-198.

[11] Bayraktar, H., Dolar, F.S. 2011. Molecular Identification and Genetic Diversity of *Fusarium* Species Associated with Onion Fields in Turkey. Journal of Phytopathology, 159, 28-34.

[12] Türkkan, M., Karaca, G. 2006. Determination of Fungal Root Rot Disease Agents Associated with Onion Fields in Amasya Province. Tarım Bilimleri Dergisi, 12, 357–363.

[13] Stankovic, S., Levic, J., Petrovic, T., Logrieco, A., Moretti, A. 2007. Pathogenicity and Mycotoxin Production by *Fusarium proliferatum* Isolated from Onion and Garlic in Serbia. European Journal of Plant Pathology,118, 165-172.

[14] Dugan, F., Hellier, B., Lupien, S. 2003. First Report of *Fusarium proliferatum* Causing Rot of Garlic Bulbs in North America. Plant Pathology, 52, 426.

[15] Bora, T., Karaca, G. 1970. Bitki Hastalıkları Surveyi, Kültür Bitkilerinde Hastalığın ve Zararın Ölçülmesi, Ege Üniversitesi Matbaası, İzmir, 80 s.

[16] Booth, C. 1977. *Fusarium* a Laboratory Guide to the Identification of the Major Species. CMI, Kew Surrey, England, 58 pp.

[17] Leslie, J.F., Summerel, B.A. 2006. The *Fusarium* Laboratory Manuel. Blackwell Publishing, USA, 387 s.

[18] Ogoshi, H. 1975. Grouping of *Rhizoctonia solani* Kühn and Their Perfect Stages. Review Plant Protection Research, 8, 98-103.

[19] Bandoni, R.J. 1979. Safranin-O as a Rapid Nuclear Stain for Fungi. Mycologia, 63, 873-874.

[20] Sneh, B., Burpee, L., Ogoshi, A. 1991. Identification of *Rhizoctonia* Species. APS Pres, USA, 133 pp.

[21] Ashby, S.F. 1927. *Macrophomina phaseolina* (Maub.) Comb. Nov. the Pycnidial Stage of *Rhizoctonia bataticola* (Taub.). Butl. Phytopathology, 17, 141-147.

[22] Goidanich, G. 1947. A Revision of the Genus *M. phaseolina* petrak type Species: *M. phaseolina* (Tassi) Goid. *M. Phaseolina* (Maubl.) Ashby. Phytopathology, 37, 449-461.

[23] Martínez-de la Parte, E., Sierra Ricabal, P.M., García Rodríguez, D., Lorenzo, M.E. 2015. First Report of Garlic Rust Caused by *Puccinia allii* in Cuba. New Disease Reports, 32, 30.

[24] Koike, S.T., Smith, R.F., Davis, R.M., Nunez, J.J., Voss, R.E. 2001. Characterization and Control of Garlic Rust in California. Plant Disease, 85, 585-591.

[25] McDonald, M.R., de los Angeles Jaime, M., Hovius, M.H. 2004. Management of Diseases of Onions and Garlic. Diseases of Fruits and Vegetables, Springer, Netherlands: Ed. Naqvi SAMH, 707 pp.

[26] Timila, R.D., Joshi, S., Manandhar, G., Sharma, S. 2005. Occurrence of Garlic Rust in Mid Hill of Nepal. Nepal Agricultural Research Journal, 6, 110-111.

[27] Sartaj, S., Ahmad, S. 2005. Identification of Rust Pathogen Species İsolated from Different Garlic Cultivars Planted in District Swabi, NWFP. Sarhad Journal of Agriculture, 21, 205-213.

[28] Mengesha, W., Tesfaye, A., Mashilla, D. 2015. Effect of Spacing in Incidence and Severity of Garlic Rust (*Puccinia allii*) and Bulb Yield and Related Traits of Garlic at Eastern Ethiopia. Plant Pathology and Microbiology, 6, 314-338.

[29] Worku, Y., Dejene, M. 2012. Effects of Garlic Rust (*Puccinia allii*) on Yield and Yield Components of Garlic in Bale Highlands, Southeastern Ethiopia. Journal of Plant Pathology and Microbiology, 3, 218-224.