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Araştırma Makalesi

# Microfungi Species on the Weeds of Agro-ecosystem (wheat ecosystem) in Adıyaman City

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**Abstract:** This study was performed between 2009-2010 to detect the micro fungi on the weed, which create problems on wheat fields of the city Adıyaman and its dependent districts. Within the field of study, 27 different micro fungi were detected on a total of 33 different weed species in the wheat fields. *Peronospora aparines* (de Bary) Gäum. causing downy mildews of *Galium aparine* L. is recorded for the first time in Turkey. The morphological characteristics of this newly-recorded species in Turkey were presented.

**Key words:** Microfungi, Mycoherbicid, New record, Turkey

# Adıyaman İli Agro- Ekosistemindeki (Buğday Ekosistemi) Yabancı Otların Mikrofungusları

**Özet:** Bu çalışma, Adıyaman ili ve ilçelerinde buğday ekim alanlarında sorun olan yabancı otlar üzerindeki mikrofungusları tespit etmek amacıyla 2009-2010 yıllarında gerçekleştirilmiştir. Çalışmanın yürütüldüğü buğday ekim alanlarında 33 farklı yabancı ot türü üzerinde 27 farklı fungal mikroorganizma saptanmıştır. *Galium aparine* L. üzerinde mildiyö hastalığına sebep olan *Peronospora aparines* (De Bary) Gaum. Türkiye için yeni kayıttır. Yeni kayıt mikrofungusun morfolojik özellikleri verilmiştir.

**Anahtar Kelimeler:** Mikromantarlar, Mikoherbisit, Yeni kayıt, Türkiye

## Introduction

In parallel with the increasing human population, nutrition demands also increase. Within the agricultural fields where different agricultural systems are applied to meet these needs, quite many problems affecting the quality and the quantity of the harvest are encountered. Plant protecting problems are among the major problems. Throughout long years, management of pest and disease agents became successful on important levels. However, unfortunately, negative effects of the chemicals have increased in living environment. Due to many negative effects of the chemicals, humans began to investigate suitable and tolerable control methods for protection of his agricultural production.

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For long years, controls of weed in our Country are mainly based on mechanical and herbicidal methods. In some local areas, herbicid application is accepted as a condition for normal production (Uygur, 2002). One of the negative effects of the herbicides is to cause the resistant plants to arise against normal using doses. Taking the negative effect of agricultural chemicals in environment in to consideration, investigations have been performed in alternative protection methods (Önen, 2003).

An alternative method in control of weed is the biological one using some pest and disease agents. These methods can be locally performed in dominant position of a weed in a large field.

Weeds display differences with respect to geographical districts, cultural plants, season and sowing date (Johnson et al., 1997). Thereby, different climatic condition can be caused in diversity with respect to pathogens as host plants. For example, rust fungi agent on *Chondrilla juncea* L. (rush skeletonweed) have several races in Europe, and many races in Turkey (Hasan and Ayres, 1990).

The use of plant-pathogen fungi on weeds is named as mycoherbicides (Greaves 1991). The first phase of the preparations used as mycoherbicides includes the detection of potential fungal microorganisms having a biological activity and the determination of their efficiency.

Associated with fungal pathogens on weeds, there are many reports in recent years (Bremer et al. 1947, Göbelez 1962, Erciş and İren 1993, Erper et al. 1997, Özrenk and Tepe 1999, Bahçecioğlu and Gjærum 2003, Sert and Sümbül 2003, Bahçecioğlu and Yıldız 2005, Bahçecioğlu et al. 2006, Tunalı et al. 2009, Erdoğdu et al. 2010, Ekici et al. 2012). However, new pathogen records are to be determined in Turkey in the future, which will contribute to the biological control of weeds. This study is new in Adıyaman district for determination of fungal pathogens on weeds of wheat flora.

## Materials and Methods

### Field Studies

The main material of this study are from weeds and fungal pathogens on them in wheat fields in Adiyaman City and its dependent districts (Kahta, Gerger, Sincik and Celikhan). This study aims to determine fungal pathogens on weeds of wheat fields.

Any symptomatic observations of fungus on weeds were accepted as infected or infested. The presence of any fungus in a field was accepted as infected. Observation rate of a fungus was made in a decade area and chosen randomly from a minumum of 10 and maximum of 20 weeds samples. After identification of the fungal organism, arithmetic mean was calculated and the observation rate of disease was determined. Thus weed species in wheat fields and their fungal pathogen species were determined together with rate and observation rate in Adıyaman district. The distribution and observation rate of fungal microorganisms was calculated based on Odum (1971) as pointed out below Formula 1 and 2.

Formula 1

F.Y.O : A/B x 100

Formula 2

F.G.O : C/D x 100

F.Y.O : % Prevalence rate of fungal microorganisms

F.G.O : % Incidence of fungal microorganisms

A : The number of fields encountered fungal microorganism

B : The total number of field sampling

C : Number of plants infested with fungus

D : The total number of plants examined

### Laboratory Studies

The host specimens were prepared according to established herbarium techniques. Host plants were identified using the Flora of Turkey and East Aegean Islands (Davis, 1965-1985). The fungal specimens were isolated from the host plants by obtaining thin sections. Slides in 5 % KOH or tap water were used for measurements.

For microscopic examination and microphotographs a Leica DM E light microscope was used. Spores were measured using a Leica DM E light microscope (objective 40x or 100x). Lenght and width of 30 spores were measured for each sample. The microfungi specimens were identified using relevant literature (Azbukina 2005, Braun 1995, Dennis 1981, Ellis and Ellis 1987, Fakirova 1991, Grove 1935, Heluta 1989, Kuprevich and Ulijanishchev 1975, Saccardo 1881-1931, Ulijanishchev 1978, Ulijanishchev et al. 1985a, b, Vanev et al. 1997, Wilson and Henderson 1966, Yaçevskiy 1917). All specimens examined were deposited in the mycological collection of the Department of Plant Protection, Faculty of Agriculture, Dicle University, in Diyarbakır province of Turkey.

**Results**

The list of microfungi with their host plant, collection sites, coordinates, altitudes, dates and the numbers of the collector (CÖ = Cumali Özaslan) is presented below. Species cited for the first time for Turkey has been remarked by an asterisk (*).

**List of Taxa**

**Ascomycota**

**Capnodiales**

**Davidiellaceae**

**1.*Cladosporium herbarum*** (Pers.) Link

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, road side, on the leaves of *Hordeum spontaneum* C. Koch, 03.05.2009, CÖ 2004.

**Mycosphaerellaceae**

**2.*Septoria convolvuli*** Desm.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Convolvulus arvensis* L., 12.05.2009, CÖ 2028.

**Erysiphales**

**Erysiphaceae**

***3.Blumeria graminis*** (DC.) Speer

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Alopecurus myosuroides* Hudson, *Aegilops* sp., *Hordeum murinum* L., *Hordeum spontaneum* C. Koch and *Phlaris* sp., 03.05.2009, CÖ 2003.

**4.*Erysiphe betae*** (Vaňha) Weltzien

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Polygonum aviculare* L., 03.05.2009, CÖ 2005.

**5.*Erysiphe convolvuli*** DC.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Convolvulus arvensis* L., 22.05.2009, CÖ 2007.

**6.*Erysiphe pisi*** DC.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Lathyrus inconspicuus* L. and *Vicia sativa* L., 22.05.2010, CÖ 2008.

**7.*Golovinomyces cichoracearum*** (DC.) V.P. Heluta var. ***cichoracearum***

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Lactuca serriola* L. and *Sonchus asper* (L.) Hill, 12.05.2009, CÖ 2006.

**8.*Podosphaera ferruginea*** (Schltdl.) U. Braun & S. Takam.

C7 Adıyaman: Center, Sincik, Samsat in wheat fields ecosystem, on the leaves of *Sanguisorba minor* Scop., 12.05.2009, CÖ 2015.

**9.*Podosphaera fusca*** (Fr.) U. Braun & Shishkoff

C7 Adıyaman: Center, Kahta, Sincik, Samsat, in wheat fields ecosystem, on the leaves of *Conyza canadensis* (L.) Cronquist, 05.06.2009, CÖ 2016.

**Pleosporales**

**Pleosporaceae**

**10.*Alternaria alternata*** (Fr.) Keissl.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Tordylium hasselquistae* DC. and *Vicia sativa* L., 03.05.2009, CÖ 2002.

**BASIDIOMYCOTA**

**Pucciniales**

**Melampsoraceae**

**11.*Melampsora euphorbiae*** (Ficinus & C. Schub.) Castagne

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Euphorbia helioscopia* L., 12.05.2010, CÖ 2009.

**Pucciniaceae**

**12.*Puccinia acetosae*** (Schumach.) Körn.

C7 Adıyaman: Center, Kahta, Sincik, Çelikhan, Samsat, road side, in wheat fields ecosystem, on the leaves of *Rumex crispus* L., 12.05.2009, CÖ 2017.

**13.*Puccinia calcitrapae*** DC. var. ***calcitrapae***

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, road side, in wheat fields ecosystem, on the leaves of *Echinops orientalis* Trautv. and *Serratula cerinthifolia* (Sm.) Boiss., 12.05.2009, CÖ 2020.

**14.*Puccinia carthami*** Corda

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Carthamus* sp., 12.05.2009, CÖ 2021.

**15.*Puccinia cirsii*** (DC.) Sacc.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Notobasis syriaca* (L.) Cass. and *Carduus pycnocephalus* L., 12.05.2009, CÖ 2022.

**16.*Puccinia coronifera*** Kleb.

C7 Adıyaman: Center, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Avena sterilis* L., 12.05.2009, CÖ 2023.

**17.*Puccinia cynodontis*** Lacroix ex Desm.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Cynodon dactylon* (L.) Pers., 22.05.2009, CÖ 2024.

***18.Puccinia falcariae*** Fuckel

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Falcaria vulgaris* Bernh., 12.05.2009, CÖ 2025.

**19.*Puccinia hieracii*** (Röhl.) H. Mart. ***var. hieracii***

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Centaurea solstitialis* L. and *Taraxacum officinale* F.H. Wigg., 12.05.2009, CÖ 2032.

**20.*Puccinia malvacearum*** Bertero ex Mont.

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat in wheat fields ecosystem, on the leaves of *Malva sylvestris* L., 22.05.2009, CÖ 2027.

**21.*Uromyces polygoni-avicularis*** (Pers.) P. Karst.

C7 Adıyaman: Center, Kahta, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Rumex crispus* L., 22.05.2009, CÖ 2018.

**OOMYCOTA**

**Albuginales**

**Albuginaceae**

**22.*Albugo candida*** (Pers.) Roussel

C7 Adıyaman: Center, Kahta, Gerger, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Myagrum perfoliatum* L., 22.05.2009, CÖ 2001.

**Peronosporales**

**Peronosporaceae**

**23.**Peronospora aparines*** (de Bary) Gäum.

Leaf spots circular to angular, yellowish later chestnut. Colonies on the lower surface of leaves, sometimes covering the entire leaf surface, grey. Conidiophores 275–450 µm long, about 8–12 µm thick, the unbranched part being of about 1/2–2/3 of the total length, 4–6x dichotomously branched, branches bent. Conidia are broadly ellipsoid, sometimes with remains of the stalk at the base, greyish, 26–30 x 16–18.5 µm. Oogonia and oospores were not detected (Fig.1).

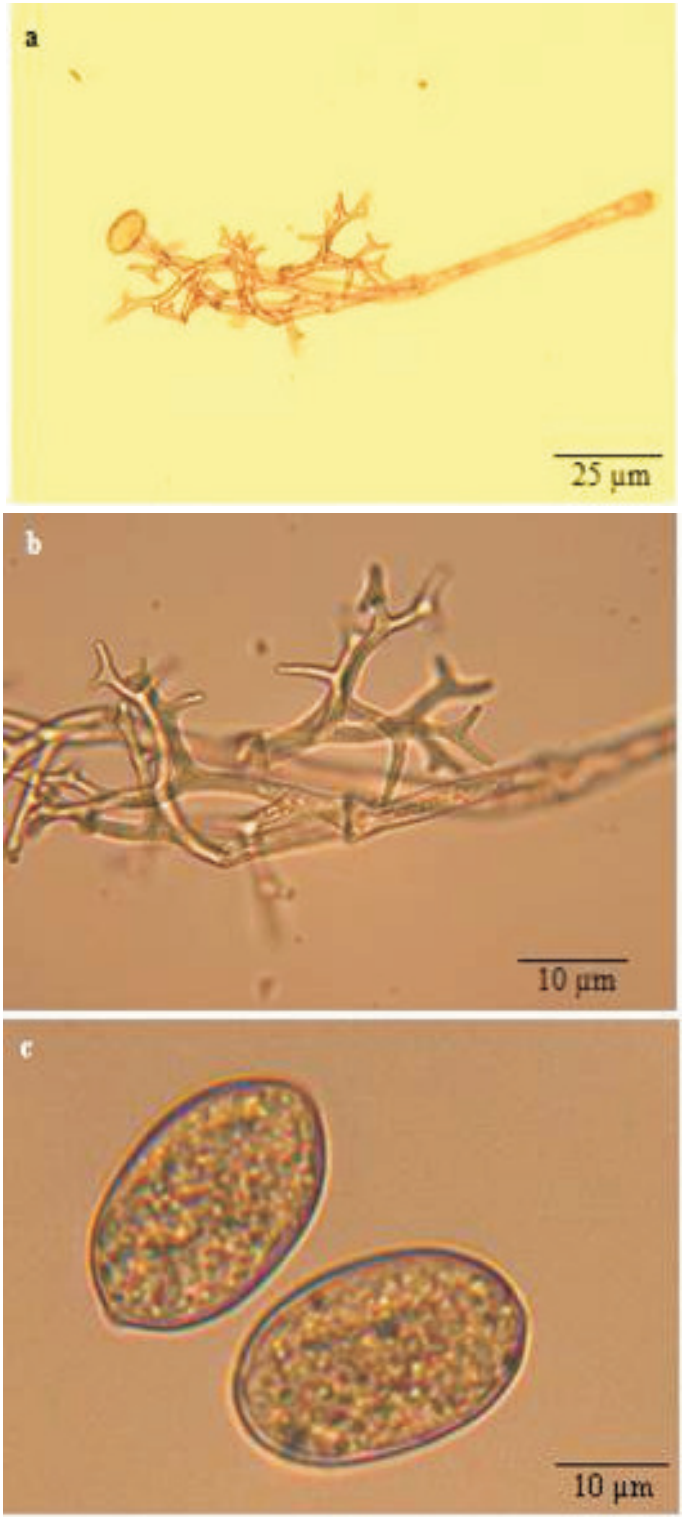


Fig. 1. *Peronospora aparines*: a. Conidiophore and conidium, b. Conidiophore, c. Conidia.

C7 Adıyaman: Center, in wheat fields ecosystem, on the leaves of *Galium aparine* L., 12.05.2010, CÖ 2010.

**24.*Peronospora arborescens*** (Berk.) de Bary

C7 Adıyaman: Center, Kahta, Sincik, in wheat fields ecosystem, road side, on the leaves of *Papaver macrostomum* Boiss. et Huet ex Boiss., 12.05.2009, CÖ 2011.

**25.*Peronospora narbonensis*** Gäum**.**

C7 Adıyaman: Center, Sincik, Çelikhan, in wheat fields ecosystem, on the leaves of *Vicia narbonensis* L., 12.05.2009, CÖ 2012.

**26.*Peronospora sisymbrii-officinalis*** Gäum**.**

C7 Adıyaman: Center, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Sisymbrium officinale* (L.) Scop., 12.05.2009, CÖ 2013.

**27.*Peronospora trifoliorum*** de Bary

C7 Adıyaman: Center, Kahta, Sincik, Çelikhan, Samsat, in wheat fields ecosystem, on the leaves of *Trifolium repens* L., 12.05.2009, CÖ 2014.

## Discussion and Conclusion

As a field surveys conducted during 2 years, totally 27 fungi species on 33 weed species were observed in wheat field of Adıyaman district. From fungal pathogens, 12 rust, 7 powdery mildews, 5 downy mildews and 3 leaf spotted pathogens were determined respectively. One fungal pathogen from them seems as a new record for Turkey.

As shown in Table 1, field studies and the prevalence rates of fungal microorganisms have been found not to show similarities. This situation emerges due to different ecosystems of weed species and fungal microorganisms.

In addition, the fields of research in the field of geomorphological structure, ecology, irrigation facilities, agricultural production capacities is thought to be effective in the diversity of crops grown. For this reason, they show differences in weed density and types of fungal microorganisms variation.

In order to use fungi microorganisms as biological control agents not only should they be effective but also they should be special to the host. Moreover, it is especially important that the host should be one of the major weeds causing problems in agricultural fields. For example, *Puccinia punctiformis*, which infects *Cirsium arvense* (local name: Köygöçüren), one of the important weed specie in Turkey, is a species having potential to be used as a bioherbicide on which substantial attention is paid in the world as well. It is accepted as one of the most important harmful weeds in the world (Holm et al. 1977), as it is reported to be the third in Europe among the most harmful weeds (Schröder et al. 1993). Osoki et al. (1979), pointed out that rust agent is effective on tackling with *Cirsium arvense.* However, in a study conducted in England, researchers reported that the effectiveness of the *Puccinia punctiformis* as a biological control agent against *Cirsium arvense* substantially increased in case it was used with 2,4 D in an integrated control program (Haggar et al. 1986). Again, *Convolvulus arvensis* L. (local name: tarla sarmaşığı) is a perennial harmful plant among the important weeds of the agricultural fields both in Europe and Turkey (Weaver and Riley 1982; Güncan 2009). In this study, different fungi species causing rust and leaf spot diseases on the serious weeds such as *Carduus pycnocephalus, Centaurea solstitialis* and *Convolvulus arvensis* were isolated. Future research efforts should be directed to these agents in order to reveal the possibility of using them as bioherbicide. More importantly, the possibilities of using the fungi agents with other weed control methods should also be considered.

*Peronospora aparines* (de Bary) Gäum. causing downy mildews of *Galium aparine* L. is recorded for the first time in Turkey.

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**Table 1.** Fungal species on weeds and their distribution and observation rates in wheat fields of Adıyaman

| WEEDS AND FUNGAL MICROORGANISMS | WHEAT FİELDS | |
|---|---|---|
| | F.Y.O (%) | F.G.O (%) |
| *Falcaria vulgaris* (*Puccinia falcariae*) | 44,62 | 46,21 |
| *Tordylium hasselquistae* (*Alternaria alternata*) | 5,00 | 23,33 |
| *Carduus pycnocephalus* (*Puccinia cirsii*) | 33,33 | 40,00 |
| *Carthamus* sp. (*Puccinia carthami*) | 5,05 | 8,33 |
| *Centaurea solstitialis* (*Puccinia hieracii* var. *hieracii*) | 48,00 | 43,00 |
| *Conyza canadensis* (*Podosphaera fusca*) | 22,00 | 17,00 |
| *Echinops orientalis* (*Puccinia calcitrapae* var. *calcitrapae*) | 42,23 | 48,60 |
| *Lactuca serriola* (*Golovinomyces cichoracearum* var. *cichoracearum*) | 7,90 | 27,40 |
| *Notobasis syriaca* (*Puccinia cirsii*) | 23,75 | 22,33 |
| *Serratula cerinthifolia* (*Puccinia calcitrapae var. calcitrapae*) | 52,55 | 46,33 |
| *Sonchus asper* ( *Golovinomyces cichoracearum* var. *cichoracearum*) | 15,00 | 16,60 |
| *Taraxacum officinale* (*Puccinia hieracii var. hieraci*) | 45,55 | 46,33 |
| *Myagrum perfoliatum* (*Albugo candida*) | 35,55 | 46,72 |
| *Sisymbrium officinale* (*Peronospora sisymbrii-officinalis*) | 25,55 | 36,66 |
| *Convolvulus arvensis* (*Erysiphe convolvuli*) | 35,55 | 16,36 |
| *Convolvulus arvensis* (*Septoria convolvuli*) | 41,25 | 70,00 |
| *Euphorbia helioscopia* (*Melampsora euphorbiae*) | 41,00 | 34,7 |
| *Lathyrus inconspicuus* (*Erysiphe pisi*) | 43,00 | 47,00 |
| *Trifolium repens* (*Peronospora trifoliorum*) | 14,72 | 22,00 |
| *Vicia narbonensis* (*Peronospora narbonensis*) | 20,00 | 40,00 |
| *Vicia sativa* (*Alternaria alternata*) | 24,54 | 30,00 |
| *Vicia sativa* (*Erysiphe pisi*) | 26,66 | 20,00 |
| *Malva sylvestris* (*Puccinia malvacearum*) | 75,60 | 60,00 |
| *Papaver macrostomum* (*Peronospora arborescens*) | 33,33 | 62,00 |
| *Aegilops sp.* (*Blumeria graminis*) | 30,00 | 78,33 |
| *Alopecurus myosuroides* (*Blumeria graminis*) | 72,72 | 86,25 |
| *Avena sterilis* (*Puccinia coronifera*) | 12,40 | 69,76 |
| *Cynodon dactylon* (*Puccinia cynodontis*) | 34,60 | 48,42 |
| *Hordeum murinum* (*Blumeria graminis*) | 21,31 | 36,15 |
| *Hordeum spontaneum* (*Blumeria graminis*) | 24,72 | 15,44 |
| *Hordeum spontaneum* (*Cladosporium herbarum*) | 16,70 | 24,79 |
| *Phlaris sp.* (*Blumeria graminis*) | 15,55 | 18,57 |
| *Polygonum aviculare* (*Erysiphe betae*) | 27,69 | 27,22 |
| *Rumex crispus* (*Puccinia acetosae*) | 59,01 | 48,33 |
| *Rumex crispus* (*Uromyces polygoni-avicularis*) | 63,51 | 55,13 |
| *Sanguisorba minor* (*Podosphaera ferruginea*) | 13,33 | 15,00 |
| *Galium aparine* (*Peronospora aparines*) | 19,72 | 31,66 |

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