STUDIES ON BASAL ROT OF ONION BULBS CAUSED BY FUSARIUM OXYSPORUM

By

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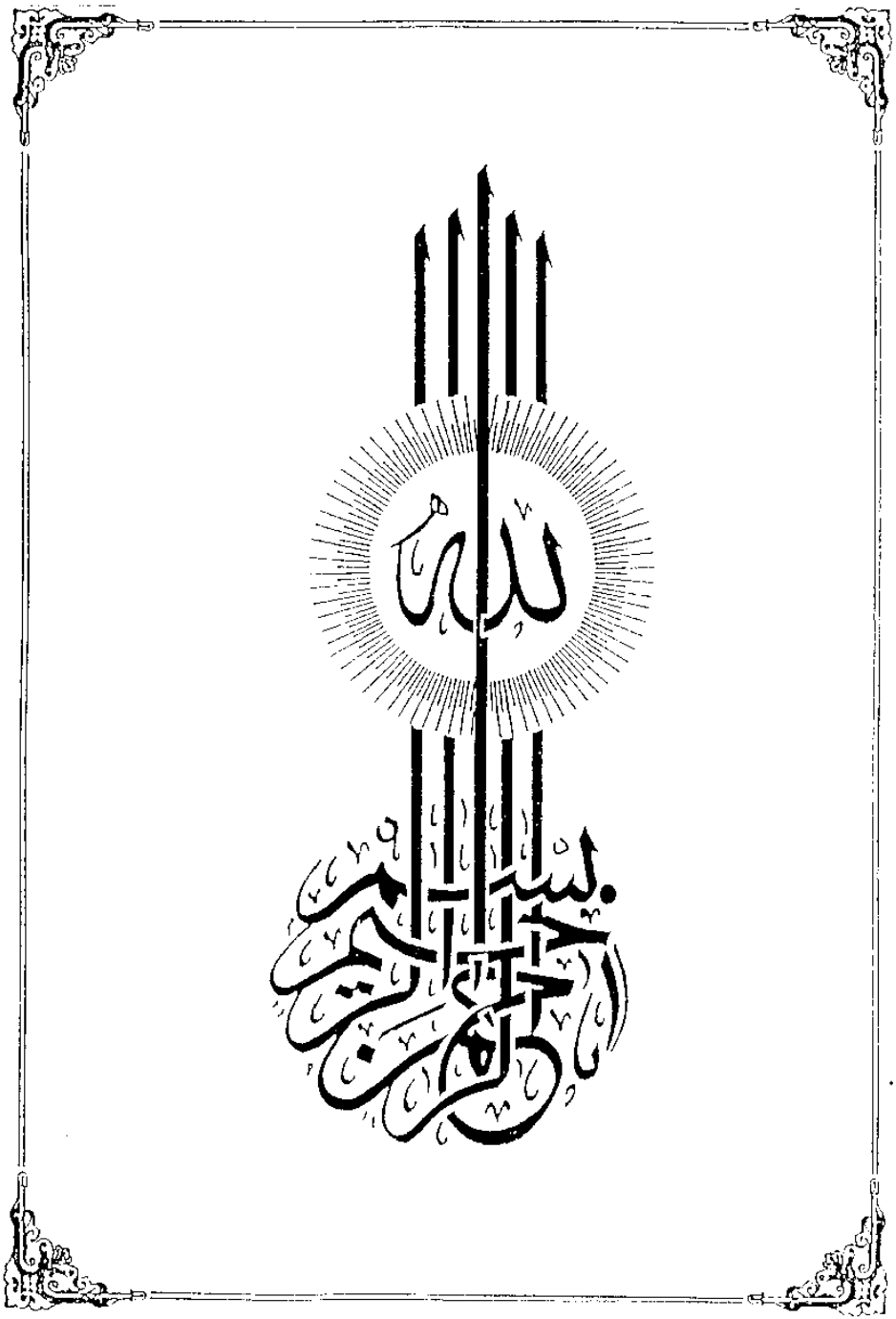

A C K N O W L E D G M E N T

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C O N T E N T S

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I N T R O D U C T I O N

Onion (Allium cepae L.) is one of the main important field crops in U.A.R. It ranks the third crop after cotton and rice. The Egyptian onion has a famous reputation all over the world due to its superior quality. Onion shares to increase the national income as it is a major source of hard currency.

Onion acarage was 191183 and 145174 feddens for the years 1967 and 1968 respectively. It is distributed all over Delta, Middle Egypt and Upper Egypt. However, its vast majority covers the Delta provinces. On the other hand, the higher percentage of the exported bulbs is obtained from the Upper Egypt.

Onions are subjected to various diseases causing great losses during growing season and along storage period or transit. Among these diseases, Fusarium basal bulb rot is wide spread, almost causing great losses in the field and also in storage (El-Helaly 1962). According to the importance of Fusarium basal rot specially during storage, the following studies were carried out:

1) Isolation and identification of the causal organism of the basal bulb rot disease and its pathogenic capabilities.
2) Some environmental factors affecting the disease under both field and storage conditions.
3) Some physiological aspects of the pathogen.
4) The cultural practices in relation to the disease and the means of control including seedling and soil treatments with different fungicides.
5) Some factors affecting the basal bulb rot during storage such as temperature, relative humidity and aeration.

REVIEW OF LITERATURE

The Causal Organism :

Bulb rot of onion was observed by Walker and Tims (1924). They found that the causal organism was *Fusarium cepae* Hanzawa and added that this fungus most resembles *Fusarium hyper oxysporum*, *F. radolens* and *F. oxysporum*.

Link and Bailey (1926) reported that several species of *Fusarium* caused bulb rot of onions. They were important factors in producing transit and storage losses. These species are wound parasites specialized in attacking species of *Allium*. The writers added that the pathogenic species were *Fusarium zonatum* Sherb. and *F. cepae*, while *F. bulbigenum* and *F. moniliforme* were found to be only sometimes pathogenic. On the other hand, *F.oxysporum* and *F. vasinfectum* were not pathogenic.

Palo (1928) concluded that *F. zonatum*, isolated from the infected tissues and inoculated into onion, gave positive results. It proved to be a variety of *F.zonatum* closely allied to, and probably identical with *F. zonatum*

forms 1. Similar results were also recorded by Welhus and Henderson (1936).

Davis and Henderson (1937) found that F. vasinfectum var. zonatum caused semi-dry rot of bulbs or roots. Ken Knight (1944) reported that the same organism caused the most serious storage disease of onions.

Anonymous (1953) reported that onions were susceptible to attck by F. oxysporum f. cepae, while Marlatt (1958), Anonymous (1958), and Dingley (1961) came to the same conclusion that this organism caused basal rot of onions.

Brien et al. (1959) reported that the basal rot that occurred in storage was due to Fusarium spp.

In U.A.R. El-Helaly et al. (1962) isolated Fusarium solani from seed surface and stored onion bulbs, F. equiseti from seedlings, F. oxysporum and F. moniliforme from bulbs.

Pathogenicity :

Walker and Tims (1924) diagnosed the characteristic symptoms of bulb rot of plants grown either from seeds or sets in artificially infested soil. They realized

the pathogenicity of Fusarium cepae by the artificial inoculation of the bulbs after being kept under moist condition.

Pelo (1928) found that bulb rot infection, probably, occurred naturally through insect injuries. He added that the disease was spread by the removal of infected bulbs from one place to another.

Davis and Reddy (1932) reported that heavy losses of onion crop were due to F. zonatum resulting from various sorts of damage; seedling blight, field bulb rot and storage bulb rot.

Melhus and Henderson (1936) studied the pathogenicity of F. vasinfectum individually or in combination with Pyrenochaeta terrestris. They concluded that the latter is the primary pathogen having the ability to invade the unwounded tissues, while the former is a secondary invader producing typical basal semi-dry rot.

Marlatt (1958) proved that F. oxysporum f. cepae is a wound parasite, that caused basal rot of onion bulbs in pots after the roots had been injured mechanically.

Szatala (1964) found that the infection with F. oxysporum f. cepae occurred almost exclusively through wounds.

Lorbeer and Stone (1965) found that Fusarium oxysporum f. cepae is capable of invading the basal plate region of the bulbs and established the pre-harvest infection of plants in the field. They added that the post-harvest infection was of minor importance.

Shalaby and Struckmeyer (1966) found that F. oxysporum f. cepae entered the onion bulbs through the stem plate and the bases of older leaves.

Physiological Conditions :

Temperature and pH :

Walker and Tims (1924) reported that minimum , optimum and maximum temperatures for F. cepae were 4 , 25 - 28 and 35°C respectively. They added that the fungus grew over a wide pH range from 2.2 to 8.4. The optimum growth was at pH 6.6.

Duplessis (1932) recorded that the best growth of F. solani isolated from onion bulbs was obtained on alkaline media. The optimum temperature was at 27.5-28.5°C

Melhus and Henderson (1936) stated that F. oxysporum thrives at high temperature. The optimum temperature for its growth in pure culture was 25 - 30°C, while in soil it was 30°C.

Davis and Henderson (1937) found that Fusarium vasinfectum var. zonatum had an optimum temperature of 28°C. The fungus grew normally within pH range from 3.8 to 7.6. The maximum growth was obtained at pH 5.4-5.8.

Mostafa and Hersheh (1956) reported that the optimum temperatures for F. moniliforme and F. oxysporum were 30° and 25°C respectively. The optimum pH value for both fungi was about 6.0.

Korobeinikova (1960) found that the optimum growth of F. oxysporum was at pH 3.5.

Kehr et al. (1962) carried pathogenicity tests with 4 isolates of F. oxysporum f. sp. cepae. Their tests made on different onions at various times showed that Fusarium could be pathogenic at 20 - 28°C.

Koslowska (1962) stated that the optimal temperature for Fusarium oxysporum growth was between 25 and 30°C. She added that the conidia germinated and the mycelia developed at pH value ranging from 2 to 9 with an optimum between 4 and 7.

Hendrix and Toussoun (1964) found that synthetic agar medium containing glucose, proline and salts encouraged the rapid and abundant formation of Fusarium oxysporum

sporodochia. They found that potato-dextrose agar medium was of less value for sporodochial formation.

Taylor (1964) found that F. oxysporum developed at temperature of 18 - 30°C with an optimum temperature of 27°C. Solid media with pH from 4 to 9 supported fungal growth.

Light :

Zacharish et al. (1956) stated that F.oxysporum culture was markedly zoned when grown in alternating light and darkness or at fluctuating temperatures. Fluctuation each of light and temperature favoured fungal sporulation. The optimum light alternation for sporulation was 12 hours light and 12 hours dark.

Carlile (1961) found that light promotes the formation of carotenoid pigments in F. oxysporum.

The consumption of sugar :

Said and Naguib (1954) studied the mode of absorption of sugars including sucrose by Fusarium moniliforme in vitro. They found that sucrose was hydrolysed by the organism into reducing monosugars. The rate of hydrolysis was always higher than that of uptake, so that there

was always accumulation of the hydrolysis products in the media.

Tolba and Salama (1958) studied the effect of temperature on the absorption and utilization of sucrose by mycelial mats of F. oxysporum in culture. They found that sucrose was hydrolysed enzymatically giving glucose and fructose. A part of these hydrolysis products was subsequently absorbed, while the rest remained in the culture media. The rate of sucrose inversion increased at higher temperatures. The highest amount of sugar absorbed was from the medium incubated at 30°C, the optimum temperature for fungal growth.

Growing Conditions :

Effect of fertilizers on :

a) Infection :

Woolliams (1928), working on bulb rot of onions, found that it became increasingly prevalent on rich and poor soils. The average of field losses was 10, and may reach 60 percent. The disease appeared early and gradually spread until the maximum infection was reached at harvest time.

Organic manure used by Walker and Blank (1933)

increased onion bulb rot as compared with inorganic fertilizers.

Duplessis (1934) mentioned that a moderate nitrogenous fertilization induced a beneficial effect on the course of the disease.

Tisdale (1952) stated that sources of plant nutrients for onions as $(NH_4)_2SO_4$, $NaNO_3$, superphosphate and K_2SO_4 produced bulbs of good keeping quality, and protected the plant from fungal diseases.

Geard (1959) recommended the avoidance of excessive nitrogen application to reduce storage losses.

b) The growth and yield of onion :

Binkely et al. (1951) showed that the use of phosphorus did not significantly increase the yield of sweet Spanish onion. They also stated that complete fertilizers containing all the three elements NPK with a high phosphorus ratio produced more satisfactory yield increases than the application of a single element alone such as nitrogen.