Study on the characteristics of mold in military aviation material warehouse

Li Li^{1*}, Zhao Hongqiang¹, Shi Yumin¹, Wang Jiongkun¹, Guo Xingxiang¹, Li Kun¹

¹Naval Aviation University Qingdao Branch, Qingdao, China, 266041

Abstract: Aviation equipment warehouse is responsible for the combat training task of the army. The existence of mold in the warehouse reduces the quality and performance of equipment, and the quality of storage equipment directly affects the strength of aviation equipment support ability. In this paper, the main characteristics of storage mold were studied, the micro morphology and colony characteristics of storage mold were analyzed, and the main types of mold in aviation material warehouse were introduced, which provided a theoretical basis for further research on the growth and control of mold.

1 Introduction

Aviation equipment is the material basis for aviation forces to complete various operations and training tasks. The shortage of aviation equipment storage in aviation equipment warehouse or the quality of aviation equipment may cause the aircraft to be grounded, resulting in the reduction of monthly aviation equipment support good rate, and then directly affect the formation of aviation combat effectiveness, thus it is difficult to ensure the smooth completion of aviation army combat training tasks. To the particularity of the mission, the environmental and climatic characteristics of the "three highs" (namely high temperature, high humidity and high salt, and even high sunshine in some places all the year round, commonly known as "four highs") are prone to the breeding and spread of mold. For example, the hose in rubber products is brittle due to mildew, which leads to the serious decline in the quality and performance of the equipment, which greatly affects the aviation equipment. It is imperative to carry out research on the characteristics of mold in military aviation material warehouse.

2 Micromorphology of storage mold

Mold is different from bacteria and yeasts. The mycelium of mold is composed of branched or unbranched hyphae. Many hyphae are interwoven to form mycelium. The hyphae of molds can be divided into two types according to the presence or absence of septum^[1], in one type of hyphae, there is no septum, and the whole mycelium is a single cell with multiple nuclei. The other type of hyphae has a septum, each segment is a cell. The whole mycelium is composed of multiple cells. There are very small holes in the center of the septum, which make the cytoplasm and nutrients communicate with each other (as shown in Fig.

1). The mycelium of mold is usually a hollow tubular structure with a diameter of 2-10 μm . when the mycelium grows, each cell will also divide and the number of cells will increase. When the mycelium of mold in the culture dish is disturbed in the growth process, small hyphae will be produced from the main mycelium, which will be branched, and will enter the reproductive state when it grows to a certain stage^[2].

Fig. 1. septate hyphae

3 Colony characteristics of storage mold

The cells of mold are filamentous and form vegetative mycelium and aerial mycelium on solid medium. There was no capillary water between the aerial hyphae, and the colonies were different from bacteria and yeasts, but close to actinomycetes. However, mold colony morphology is larger, texture than actinomycetes loose, dry appearance, opaque, or tight or loose spider like, fluffy or cotton floc. The colony is closely connected with the culture medium and is not easy to pick. The color of the positive and negative sides and the edge of the colony are often inconsistent with the color of the center. The color difference between the positive and negative sides of the colonies is due to the darker color of the aerial hyphae and their differentiated fruiting bodies (spores, etc.) than the

*Corresponding author: qdxqlxia@163.com

vegetative hyphae dispersed in the solid matrix. The physiological age of the aerial hyphae in the center of the colony is older than that in the edge of the colony, and its development, differentiation, maturity and color are relatively high^[3]. The obvious differences in color and morphological structure between the central and marginal aerial hyphae are formed, as shown in Fig. 2.

Fig. 2. mold colony

The following table compares the characteristics of colonies and cells of molds and bacteria. From the comparison in the table, it can be seen that there are great differences between molds and bacteria in many aspects of cells and colonies, such as the morphological characteristics of cells and the appearance and transparency of colonies, etc.

Table 1. colony and cell characteristics of mold and bacteria

project		Bacteria (single celled microorganisms)	Mold (filamentous microorganism)
Cells	nucleus	Prokaryote	Eukaryon
	Arrangement	Single scattered or arranged in a certain way	Silk interweaving
	morphological character	Small and uniform ^① Some of them have spores	Rough and differentiated
colony of bacteria	Water bearing state	Very wet or wet	dry
	Appearance form	Small and protuberant or large and flat	Large and loose or large and dense
	transparency	Transparent or A little transparent	Opaque
	The degree of combination with culture medium	Uncombined	More firm
	color	various	various
	Color difference between front and back	nothing	Yes
	edge ^②	There are no cells in general	Thick linear cells can be seen

Cell growth rate	Soon	Faster
smell	Generally, it has a bad smell	It often has a musty smell

Note: ① "uniform" refers to that the cells seen under high-power microscope are only uniform, while "differentiation" refers to some fuzzy structures inside the cells.

② Observe with low power microscope.

4 Main types of storage mold^[4-5]

4.1 Aspergillus

The mycelium of *Aspergillus* has a septum, and the mycelium is composed of multicellular hyphae. It is usually colorless and turns light yellow to brown when it matures. Vegetative mycelium creeps on the surface of the medium. The top of the conidiophore expanded into a apical sac. The apical sac was generally rod-shaped, elliptic, hemispherical or spherical. On the surface of the apical sac, one or two layers of pedicels are radiated, called primary and secondary ones. There are a series of conidia on the peduncle. See Fig. 3. Only a few species of *Aspergillus* have sexual stage, producing enclosed ascospores and ascospores.

The colony color of *Aspergillus* is diverse and stable, which is one of the main characteristics of classification. The conidia are yellow, green, orange, brown and black. The length of conidiophore, the shape of apical sac (single round or double round), the shape, size, surface structure, especially color of conidia are the basis of species identification.

Fig. 3. *Aspergillus*

4.2 Penicillium

Penicillium is widely distributed in the warehouse. There are many kinds of *Penicillium*. The vegetative mycelium of *Penicillium* is colorless, light colored or has bright color. It has a transverse septum, and the conidial stalk also has a transverse septum, smooth or rough. There are no podocytes at the base. The tip does not form an expanded apical sac, but forms a broom like branch. The conidia are round, elliptic or short columnar, smooth or rough. Most of them are blue-green or grayish green when growing. A few species produce a closed capsule, which forms ascospores and ascospores, and a few species produce sclerotia. The colonies of *Penicillium* are mostly cyan, and gray white, yellow brown and even red are also found, but few. See Fig. 4. According to the different branching ways of *Penicillium*, *Penicillium* can be divided into four groups: Unicyclic *Penicillium* group, the broom branch is composed of single round peduncle;

symmetrical bicyclic *Penicillium* group, the broom branch has two rows of branches, left and right symmetry; symmetrical multicyclic *Penicillium* group, the broom branch has multiple branches and symmetry; asymmetrical multicyclic *Penicillium* group, the broom branch has two or more branches, left and right asymmetry.

Fig. 4. *Penicillium*

4.3 Rhizopus

The hyphae of *Rhizopus* have no septum, but have stolon. There are rhizoids at the end of the stolon, and the spore stalk of the formation group is on the stolon at the rhizoids. The sporangia are spherical or nearly spherical. *Rhizopus* is a unicellular fungus.

Rhizopus is widely distributed in the warehouse and is a common mold. It's very adaptable to the environment. The young colonies were white and fluffy. The middle stage is grayish black. After ripening, the hyphae are densely covered with black spots, namely sporangia.

When the vegetative mycelia grew on the medium, the vegetative mycelia produced the creeping mycelia with arc growth and spread around. When the creeping hyphae contacted with the medium, they differentiated into a cluster of rhizoids. The sporangium is called sporangium, which is an upright sporangium which is produced from the rhizoid position upward, and its top is expanded to form a round sac. There are many spores in the cyst. The axis of sporangium is obvious, spherical or subglobose, and there is a receptacle at the base of the axis connecting with the stem. After maturation, the sporangium wall ruptured and released spores, which were mostly spherical, ovate or irregular. See Fig. 5.

Fig. 5. *Rhizopus*

4.4 Mucor

Mucor is also widely distributed, forming grey, white or yellowish brown cotton floc colonies on the surface of the substrate. Most of them are saprophytic and grow rapidly. The mycelium of *Mucor* has no rhizoid and creeping branches. The sporangium stem is produced directly from the mycelium, usually single, and the mycelium has few

or no branches. When the mycelium is mature, round or columnar or plow head shaped sac axis is formed at the top, and a spherical sporangium is formed around the sac axis. Needle like calcium oxalate crystals are often found on the wall of the cyst. There is no sac support at the junction of the sac axis and the cyst stem, as shown in Fig. 6. There are three types of sporangium stalk: unbranched, racemose and pseudo axial. *Mucor* is often found in wet and low temperature places, and in the storage environment, it is mainly on the wet wall and floor.

Fig. 6. *Mucor*

4.5 Trichoderma

Trichoderma is flat colony on the medium. *Trichoderma* colony grows rapidly, and is in the form of cotton floc or dense bundle. The surface of colonies was green in different degrees. The hyphae of *Trichoderma* are transparent, septate and white in the initial stage.

The conidiophore of *Trichoderma* is the short lateral branch of mycelium with opposite or alternate branches. On the branch, it can continue to branch, forming secondary and tertiary branches. The end of the branch is a small peduncle, which can produce different conidia, such as bottle, bundle, opposite, alternate or single. Conidiospores are produced successively from the peduncles, and they are gathered into spherical or nearly spherical spore heads by mucus. Conidia are spherical, elliptic, cylindric or obovate, with smooth or rough walls, transparent or bright green. See Fig. 7.

Fig.7. *Trichoderma*

Trichoderma is widely distributed in soil and can be found in wood and other articles. Some strains can decompose complex organic matter such as cellulose and lignin. *Trichoderma* often causes mildew of wood products, leather and other fibrous materials, and causes certain harm to storage materials.

5 Conclusion

A large number of precision instruments are stored in the military aviation material warehouse. Once the temperature and humidity are appropriate, mold spores

can rapidly propagate on a variety of substrates. Mold has great destructive effect on leather, rubber, glass, metal and other materials. It can secrete various enzymes, organic acids, nucleic acids and other substances, reduce the strength of materials, cause metal corrosion, and affect the performance of equipment ^[6-8]. It is imperative to study the characteristics of mold in aviation material warehouse, to study the growth and reproduction law, to find a breakthrough, and to find the prevention and control methods of mold.

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