Phytotoxicity in Foxtail millet seed polluted batik wastewater and its reduction by ArbuscularMycorrhizal Fungi

RatnaStia Dewi1*, MardiyahKurniasih2, Uki Dwiputranto1

1Microbiology Department, Faculty of Biology, UniversitasJenderalSoedirman, Jl. Dr. Soeparno 63, Purwokerto 53123, Indonesia
2Chemistry Department, Faculty of Mathematics and Natural Sciences, UniversitasJenderalSoedirman, Jl. Dr. Soeparno, Purwokerto 53123, Indonesia
ratna.dewi0509@unsoed.ac.id

Abstract. The aim of this study was to determine the effect of giving ArbuscularMycorrhizal Fungi (AMF), to the toxicity of Millet seeds (Foxtail millet) contaminated with batik waste water. This study used seeds contaminated with batik waste water with the addition of AMF and without AMF (negative control), as well as water-treated waste, Millet seeds that were not polluted with batik waste water with and without AMF added with distilled water (positive control). The results showed that AMF addition had an effect on reducing the toxicity of Millet seeds contaminated with batik waste water. Millet exposed to batik waste water with the provision of AMF + water produced the best value of 57.78% germination, 42.22% inhibition, highest leaf length 1.13 cm, plumulae 1.89 cm, radics 1.58 cm. The provision of AMF is promising in preventing pollutants from entering plants as well as improving soil quality.

1. Introduction
ArbuscularMycorrhizal Fungi (AMF) is an association between certain fungi and plant roots by forming complex interwoven interactions. AMF is known as soil fungi because its habitat is in the soil and is in the rooting area of the plant (rhizosphere). Besides being referred to as soil fungi, AMF is also commonly said to be root fungi. The specialty of this fungus is its ability to help plants to absorb nutrients especially phosphorus nutrients or P [1]. Besides being useful in increasing nutrient absorption, AMF increases plant tolerance to degraded land conditions in the form of drought and the presence of heavy metals. This function is used as an alternative technology to assist growth, increase productivity and quality of plants grown on marginal lands [2].

AMF can protect host plants from the absorption of these toxic elements through the effects of filtration, complexation and accumulation. AMF can act as a biocontrol of heavy metal absorption, and can help plants avoid heavy metal poisoning [3]. AMF symbiosis also increases plant resistance to extreme drought and humidity, helping to accumulate substances that are poisonous to plants such as As, Cr, and Pb [4]. The AMF genus Glomus associated with plants has been proven effective in absorbing heavy metals, namely Cd, Zn, and Pb. The things above show that AMF inoculation is very important in the process of plant growth and absorption of heavy metals in polluted soils [5]. Another section of your paper.

Batik waste contains 0.1385 mg / l total Crom, 2.0587 mg / l Iron, 0.2696 mg / l Copper, 54.7175 mg / l Zinc, 0.0063 mg / l Cadmium, 0.2349 mg / l Lead (Riwayat). The content of this metal can
accumulate in the environment, for example on the ground. Batik waste from many home industries is discharged into the environment without processing. The metal content is bad for exposed plants and also for seeds. Seed germination bioassay research shows that when a dye solution is used, the results inhibit seed germination [6].

Millet ranks sixth as the most important grain and consumed by one third of the world's population. One of the main sources of energy providers, protein, vitamins and minerals, rich in B vitamins, especially niacin, B6 and folacin as well as essential amino acids such as isoleucine, leucine, phenylalanine and threonine and contain nitrioleoside compounds that play an important role in inhibiting the development of cancer cells (anti-cancer), also reduce the risk of heart disease (arteriosclerosis, heart attack, stroke and hypertension). Millet thrives in high-temperature areas, limited water availability, without the application of fertilizers and other technological inputs, and in critical lands that are difficult to plant other grains such as wheat and rice [7]. batik waste removal experiments on millet seeds need to be done because this plant is considered good on critical land.

The provision of AMF is promising in preventing pollutants from entering plants as well as improving soil quality, however, toxicity is still not studied. This study aims to determine the effect of AMF administration on the phytotoxicity of F. millet seeds contaminated with batik waste water.

2. Methode

2.1. Material
AMF used is a mixture of Glomus sp., Glomusmanihotis, Glomusetunicatum, Gigaspora margarita, Acaulosporaspinosa with a zeolite carrier containing 20-30 spores / gram. The seeds used in this study were Millet (F. millet).

2.2. Evaluation of Phytotoxicity
Sterilized millet seeds are germinated in petri dishes that have been sterilized with sterile cotton [8], then stored at room temperature. seeds on cotton surfaces are sprayed with each treatment solution every 24 hours to reach 80%. The treatments used were seeds exposed to batik waste added with AMF and without AMF (negative control), waste given distilled water, Millet seeds were not polluted with batik waste water with and without AMF added with distilled water (positive control). The study was carried out at room temperature. Percentage of seed germination and inhibition were estimated, leaf length, shoot length (plumule) and root length (radicle) were measured after 9 days.

3. Result and discussion
Phytotoxicity is used to measure the level of plant poisoning caused by pollutants. Batik waste exposed to Millet seeds results in damage to seeds which can inhibit millet growth resulting in other variables being disrupted. AMF application reduces the toxic effects of batik waste.

The results showed that AMF administration affected the level of weed puzzle poisoning as indicated by the calculation of germination, inhibition, measurement of leaf length, plumulae, and radicle. The AMF + Water + waste treatment results in a lower level of poisoning against F. millet compared to the administration of only waste or AMF + waste. This is characterized by a higher level of germination, lower inhibition, longer leaves, higher plants and longer roots.

The percentage values of F. millet germination and inhibition in the treatment of Water, Effluent, AMF + Water, AMF + Effluent, AMF + Effluent + Water 88.89%, 21%, 100%, 52.22%, 57.78% and 11.11%, 79%, 0%, 47.78 %, 42.22% (Figure 1). The length of F. millet leaves was 1.36, 0, 1.029, 0.57,1.13 in the treatment of Water, Effluent, AMF + Water, AMF + Effluent, AMF + Effluent + Water (Figure 2). Shoot lengths (plumules) of F. millet with the treatment of Water, Effluent, AMF + Water, AMF + Effluent, AMF + Effluent + Water are 6.52, 0, 6.4, 0.78, 1.89 cm, respectively (Figure 3). Whereas for root lengths (radicles) are 4.3, 0, 2.45, 0, 1.58 cm (Figure 4).
Figure 1. Effect of treatment on germination and inhibition of *F. millet*.

Figure 2. Effect of treatment on leaf length of *F. millet*.

Figure 3. Effect of treatment on shoot lengths (plumule) of *F. millet*.
Figure 4. Effect of treatment on root lengths (radicle) of *F. millet*.

Millet seeds immersed in water showed 88.89% germination, leaf length & roots and plumulae were higher than those exposed to batik waste showed 21% germination as well as leaf length, roots and plumulae. Batik waste shows signs of toxicity compared to water treatment, whereas seeds treated with the addition of AMF exposed to batik show a higher value in leaf and root length. The results showed that seedlings treated by AMF reduced millet toxicity, which showed that AMF was efficient in reducing toxicity. These results are in line with previously reported studies that the toxicity of pollutants can be reduced using AMF (kedia, dias, money). the efficiency of reducing the toxicity of millet exposed to batik waste and other treatments can be seen visually in Figure 5.

Figure 5. *F. millet* on variations in the treatment of AMF and water.

Explanation:
(a) Millet + Water
(b) Millet + AMF + Water
(c) Millet + Effluent
(d) Millet + AMF+ Effluent
(e) Millet + AMF + Effluent+ Water
In addition to suppressing AMF toxicity, it plays a good role in the growth of proven seedlings that are exposed to water better in germination (100%) than without AMF (88.89%). By plants, (2) increasing tolerance to heavy metal contamination, drought, and root pathogens, and (3) providing access for plants to utilize nutrients that are not available to be available to plants [9]. AMF can dissolve heavy metals in batik waste. The secretion of secondary metabolites produced by AMF can be in the form of organic acids, causing the micro elements to be easily dissolved. The situation with acidic pH causes the heavy metals contained in the medium to become soluble and actively absorbed by plants [10]. AMF plays an important role in protecting plant roots from toxic elements, including heavy metals. The mechanism of protection against heavy metals and toxic elements by AMF can be through the effects of filtration, chemical deactivation, or the accumulation of these elements in hyphae fungi. Absorption of micro elements by AMF plants depends on several factors, namely the physical-chemical condition of the soil, soil fertility, pH, type of plants, and the concentration of micro elements in the soil [11]. This occurs because AMF is known to be able to bind the metal to carboxyl groups and pectak compounds (hemisesululose) on the AMF contact matrix and host plant, on the polysaccharide sheath and hyphal cell wall [12]. AMF can bind metal ions in the cell walls of HIV and can protect plants from these metal ions. Heavy metals are stored in crystalloids in mycelium fungi and in root cortex cells in plants using AMF [13].

Figure 5c shows millet seedlings exposed to batik waste that cannot grow properly, Figure 5d and 5e show better growth of seedlings with the addition of AMF. At low concentrations of heavy metals does not affect plant growth but at high concentrations will cause plant damage [14]. AMF can increase plant tolerance to toxic metals by accumulation of metals in external hyphae thereby reducing its absorption into host plants. The use of AMF in bioremediation of polluted soils, in addition to the accumulation of these materials in hyphae, can also be through the mechanism of metal complexing by external hyphae secretions. This shows that there is a filtration mechanism, so that the toxic material is not absorbed by plants [15].

Plants gain a lot of benefits from being associated with AMF. AMF is able to replace 40% Nitrogen and 25% Potassium. In addition, AMF can also protect against soil infectious diseases and increase plant resistance to drought [16]. AMF can produce growth regulators, be able to form physical barriers and issue certain antibiotics to block the development of soil borne pathogens, and help plants competing with weeds [17].

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