ISSN NO: 2771-8840
Date of Publication: 28-08-2022

Effects of fertilizers on the traits of *Aloe vera* Plants infected with fungus *Rhizoctonia solani*

Mazin Badri AL-Ethawi, *Huda Hazim AL-Taae
Plant Protection Department, Agriculture and Forestry College, Mosul University, Mosul, Iraq
*Corresponding author: E-mail: dr.huda@uomosul.edu.iq

Abstract: This study was conducted in a greenhouse at the Plant Protection Department, Agriculture and Forestry College, Mosul University, Mosul, Iraq, to study the causative pathogen for root and stem-end rot of Aloe vera plants. In addition to examining the effectiveness of various types of fertilizers in preventing aloe vera plants from becoming infected with pathogenic fungus, this paper will also study their capacity to enhance the plant's development features . The isolation and diagnosis results revealed the related fungal species *Rhizoctonia solani, Fusarium solani, Alternaria alternata, Cliendero carbon spp, Fusarium oxspurium, Aspergalus flaves, Aspergalus negir, and Pincillum spp* to the aloe vera plant, where Rhizoctonia solani took the lead, which is the most frequent fungus.

The study revealed that several types of fertilizers (biological, equalizer 20:20:20, and nano) had a positive effect on *aloe vera* plants by decreasing the incidence and severity of infection with the pathogenic fungus *R. solani* in variable amounts compared to the standard contaminated treatment with the pathogen, which produced the highest percentage of infection and its severity on the shoot and root system, 90%, 0.54, 100%, and 0.68, with a significant difference from all fertilization treatments, and the bio-fertilization treatments consisting of fungi *Trichoderma harzianum*, bacteria *Bacillus subtilis*, algae, water, and humic acid outperformed In reducing the percentage of infection as well as its severity with the pathogen by 18.51% and 0.12 on the shoot and by 21.55% and 0.18 on the root system, It is then followed by the treatment of NPK nano fertilizer and the two techniques of application, watering and spraying.

The result showed that the bio-fertilizer treatment was exceptional to the fertilizer treatments in addition to the infected and healthy standard treatments, in terms of height ,width, number of leaves and offshoots, wet weight of *aloe vera* leaf, the weight of wet and dry peel, gel weight, root length, and others, with an average of 19.11 cm and 19.4 cm, and 17.33, 4.64, 26.67 gm, 13.11 gm, 6.07 gm, 13.5 gm, and 46.55 cm respectively.

Keywords: *Aloe vera*, *Rhizoctonia solani*, Bio-Fertilizer, Nano-Fertilizer

Introduction

Aloe vera is a plant that grows in the desert, where it tolerates harsh environmental conditions, including lack of water. It also grows naturally in tropical and subtropical regions, where the climate is typically hot and dry. *Aloe vera* has many benefits as it is one of the medicinal plants, so it has many unique and rare compounds that have medicinal benefits. In addition, this plant is succulent with thickened, green, fleshy, and waxy leaves on its leaves. (Panovska et al., 2005; Al Nuaimi, 2010).

Aloe vera has acquired many names throughout history, including Aloe, the Miracle Plant, and the Plant of Immortality. Furthermore, *Aloe vera* is considered a herbal remedy because it contains antioxidants and antimicrobials, but its most popular name was the "plant of immortality," which the ancient Egyptians called it because they believed in the plant's ability to treat a variety of diseases. In addition, its ability to survive despite harsh conditions is also the botanical name of the plant, *Aloe bardensis* Miller, and the common name is *Aloe vera*. *Aloe vera* is a member of the *Asphodelaceae* (Liliaceae) family, which contains at least 300 species, many of which have been utilized as botanical medicines. (Rajasekaran et al., 2006; Nazar et al., 2011).

Aloe vera leaves have many features, such as an important variety of minerals like potassium, calcium, sodium, and magnesium, which are important for human health. It also contains about twenty amino acids and some fatty acids, the most important of which are oleic, linoleic, and stearic (Tungala et al., 2011). It

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

also contains (A,B, and C) vitamins that are used as antioxidants, in particular vitamins A and C. (Rajesh et al., 2012).

Aloe vera is also one of the rare plants that contains vitamin B12. In addition, it has active compounds that contain 200 biologically active substances, including vitamins, enzymes, minerals, sugars, lignin, anthracnose, saponins, salicylic acid, amino acids, and phenolic compounds. (Park et al., 2006; Pankaj et al., 2013). Actually, the properties and components that *aloe vera* carries make it an essential part of the manufacture of cosmetics and various creams. It is also used to treat digestive disorders, colon cancer, and diabetes, and to reduce cancerous tumors. (Manvitha; Bidya, 2014; Pandit et al., 2012).

Aloe vera leaves contain a gel, which is a viscous, colorless liquid that contains several compounds, including anthraquinones, glycosides, glycoprotein, and prostaglandins, which are responsible for stabilizing the fungi's growth and reducing the activity of pathogens such as *Aspergillus niger, Botrytis cinerea, Penicillum digitatum, Aspergillus flavus,* and *Fusarium solani* (Sitara et al., 2011; Manvitha et al., 2014).

The *aloe vera* plant gets infected with many mycobacterial pathogens such as fungal pathogens (Avasthi et al.,2011; Shaker et al.,2016; Avasthi et al.,2018), bacterial pathogens (Goffin et al.,2013; Perves et al.,2016). Currently, the use of biological fertilizers (microorganisms) has increased. It is an important technology being used in agriculture to increase production and improve quality. Also, the presence of microorganisms in bio-fertilizers has an essential role in maintaining the ecosystem, improving the chemical, biological and physical properties of the soil, as well as Nano-Fertilizer in stimulating plant growth, and increasing productivity. (Sahoo et al.,2013; Mishra et al.,2017).

Materials and Methods

Isolating the pathogen that accompanying *aloe vera* plants

Aloe vera plants obtained from various nurseries in the Nineveh Governorate exhibited symptoms such as wilting leaves, brown lesions, and discolored roots. The plants were carefully transported to the lab at the University of Mosul's Plant Protection Department at the College of Agriculture and Forestry. They were later cleaned for two hours under running water to remove any remaining dirt. Different parts of the crown, leaves, and roots of the plant were collected. The parts were then cut into small pieces measuring 4-5 mm with a sterile scalpel, soaked in 1% sodium hypochlorite solution (Naocl) for 3 minutes, and rinsed for 1 minute with distilled water to get rid of any leftover sterilization material. The parts were placed between two sterile filter papers, and then the sterilized pieces were spread in 9 cm-diameter Petri dishes containing (PDA) Potato Dextrose Agar as a growth medium, which was sterilized in an autoclave for 20 minutes at 121 °C. and 1.5 kg/cm2 of pressure, and then dosed with 50 mg/L of the antibiotic chloramphenicol to eliminate any residual bacteria. These different plant pieces were grown separately at a rate of five pieces per plate, and the plates were incubated for seven days at 25 + 2 °C.

After purifying the isolates, a microscopic inspection was done to identify the most prevalent fungus. The percentage of fungal recurrence was obtained from the following equation:

$$\textit{percentage of fungal recurrence\%} = \frac{\textit{Number of pieces in which fungus appeared in the dishes}}{\textit{Total number of pieces used in the sample}} \times 100$$

The effect of several types of fertilizers on *Rhizoctonia solani* infection

In order to study the types of fertilizers and their effects on healthy and infected *aloe vera* plants, an experiment was conducted in the greenhouse of the Plant Protection Department using a Randomized Complete Block Design (RCBD) with three replications and six treatments per replication. The following treatments were included in each replication:

1-*aloe vera* plant Pots containing soil free of pathogen contamination (standard treatment is not contaminated/positive).

2-*aloe vera* plant pots containing pathogen-contaminated soil (standard treatment contaminated/negative).

3- *Aloe vera* plant Pots containing soil contaminated with the pathogen + treated with bio health fertilizer, which consists of water-soluble granules containing 75% humic acid, *Trichoderma harzinum* fungus, and *Bacillus subtillus* bacteria at 10%, algae by 5%, and water by 10%, and taken in the proportion of 8 g/liter of

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

water (Al-Shaheen et al., 2018). It is added 100 ml per watering pot, and there are nine pots in this treatment.

4-*Aloe vera* plant Pots containing soil contaminated with the pathogen + in addition to the traditional fertilizer (synthetic fertilizer) NPK 20:20:20, 2.5 g/L were added and 100 ml/pot were taken from it. The number of pots in the treatment was nine plant pots. (Mounir and Rabie, 2017).

5–*Aloe vera* plant Pots containing soil contaminated with the pathogen + the compound NPK nano-fertilizer with a ratio of (36:12:12), which is made in Iran by KHazra Company, 2g/L was taken of the NPK fertilizer (Al-Obaidi, 2021) and sprayed on the plants, so it was watered at a level of 100 ml/plant pot. Also, there were three experimental units in the treatment. Each experimental unit had one plant pot for each kind of fertilizer. The capacity of the plant pots was 6 kg, and a diameter of 24 cm was planted for each experiment. The soil, previously sterilized with formalin, was also planted with *aloe vera* plants (same age) at an average of plant/pot after contaminating the soil with the pathogenic on Petri dishes that contained pre-sterilized PDA, where each plant pot contained the same ratio. In addition to the other plants pots which are uncontaminated planted with aloe vera plant/pot as a positive treatment.

On Aug,15, 2021, after the end of the experiment, the percentage of infection and its severity on the shoot and root systems, as well as the shoot and root features which were studied, Also estimated the percentage of infection for both the shoot and root systems according to the following equation:

$$\textit{Percentage of infection \%} = \frac{\textit{N.O of infected plants}}{\textit{Total N.O of the plants}} \times 100$$

- The severity of infection was also estimated on the shoot system of the infected *aloe vera* plants, according to the pathological guide consisting of four categories:

Level	% of the infected plant part
0	Zero
1	1–25
2	26-50
3	51-70
4	71-100

- The severity of infection was also estimated on the shoot system of the infected aloe vera plants according to the pathological guide consisting of four categories :

Level	area of lesion over the crown area/mm
0	Zero
1	1-3
2	4-6
3	7-9
4	More than 10

The severity of the infection was estimated for the shoot and root systems according to the following equation:

$$\textit{Infection severity} = \frac{\textit{Plants No from category (1)} \times \textit{pathological guide} + \ldots + \ldots.. + \textit{plants N.o from category (4)} \times \textit{its table}}{\textit{total No of examined plants} \times \textit{the highest pathological guide.(McKinney ,1923).}}$$

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

Features of The shoot system :

1- The No of plant's leaves (leaf/plant) was calculated in every experimental unit.
2- The No of offshoots (offshoot/plant) was calculated in every experimental unit.
3- Plant height (cm), measured from the surface of the soil to the top of every plant by the ruler.
4- The leaf length (cm) was measured by the ruler.
5- The plant's width (cm) was measured by the ruler in every experimental unit.
6- The *Aloe vera* gel's weight (g) was determined using an electronic scale.
7- The CCI: The chlorophyll content was measured by the chlorophyll content meter (CCM 200 Plus), and measured by the CCI unit (Chlorophyll Content Index) according to (Biber, 2007). Hence, the average result of 5 leaves from each plant in each experimental unit was taken.
8- The leaf width (cm): the average result of 5 leaves from each plant in each experimental unit was extracted.
9- The leaf thickness (mm): The thickness was measured using Digital's Virnia from the middle of *Aloe vera* leaves by taking an average of 5 leaf/plant .
10- The weight of the wet and dry leaves for the shoot system(g): The shoot and root systems were separated from the crown, then cleaned from the dirt. The weight of the wet leaves was measured by a sensitive electronic scale, then collected in perforated paper bags, and dried in the oven for 72 hours at 65°C until the final weight was stable. The dry weight of each experimental unit was then measured.
11- The leaf dimensions (cm): Leaf dimensions were measured at the end of the experiment by putting a completely grown leaf in a printer machine. Then the real leaf dimensions were measured by using ratio and proportion in the following equation:

$$leaf\ dimensions = \frac{weight\ of\ leaf\ printed \times printed\ paper\ dimensions}{weight\ of\ printed\ paper}$$

(Patton, 1984)

Features of the root system:

1- The wet and dry root system weight (g): after the separation of the shoot and root systems from the crown, they were cleaned from the dirt. The weight of the wet root was measured by a sensitive electronic scale, then collected in perforated paper bags, and dried in the oven for 72 hours at 65°C until the final weight was stable. The dry weight of each experimental unit was then measured.
2- The length of the root (cm): the length of the longest root was measured by the ruler to extract the average. The results were statistically analyzed and the experiments were tested according to Duncan's polynomial test at 0.05 probability level.

Results and Discussion

Diagnosis and Isolated the pathogenic which was accompanying *aloe vera* plant

The microscopic examination of the samples shows different symptoms of the fungal *Rhizoctonia solani*. In addition, it shows symptoms of root and stem rot, as well as dwarfing root and brown lesions disease in the crown, with an individual fungal colony on the growth medium of potato dextrose agar (PDA). The fungal colony diameter reached 8,5 cm after seven days of incubation at 25 ± 2 ° C, and by conducting a microscopic examination of the growing colony using an x40 zoom, it was found that the mycelia is divided and consists of a big mass of branching (hyphae) which is almost at right angles with the basic mycelia, and also shows the septum near the emergence of the hyphae, with a clear reduction in the hyphae. (Figure 1, A&B).

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

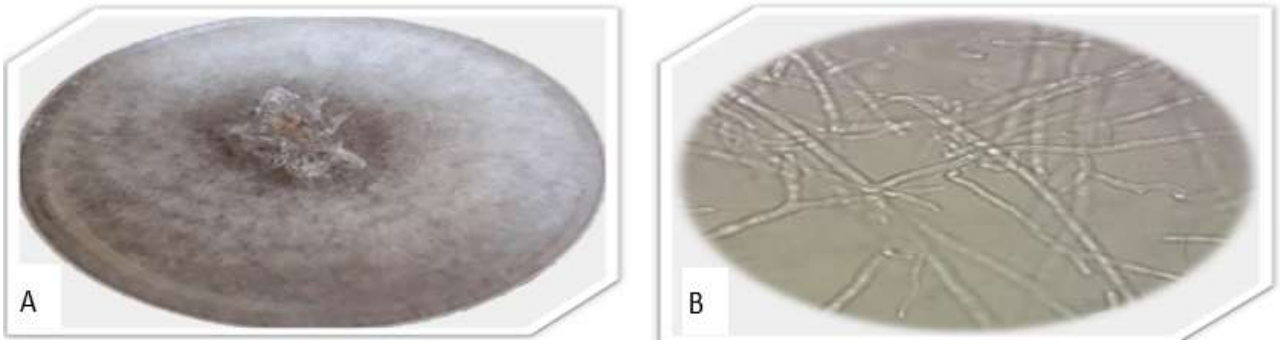

Figure (1): A - fungal colony *Rhizoctonia solani* B- Mycelium growing on growth medium PDA.

The shoot system mycelia hyphae of *R. solani* are characterized by being composed of long cells that hyphae at right angles to the basic hyphae. in addition to the shoot system at the contact points with the basic hyphae, and these features constitute the differences between this fungus and others. Furthermore, the perforated septum between cells allows movement of cytoplasm, mitochondria, and nuclei between cells, and these features are the same as in *R. solani*. (according to Parmeter and Whitney, 1970).

The effect of different fertilizers on the percentage and severity of the infection with the *R.solani* on the root system of *aloe vera* plants

The results of the statistical analysis presented in figures (2, 3) indicate that all fertilizer treatments reduced the percentage of infection and its severity with the pathogen *R. solani* at different rates on the root system, which compared to the contaminated standard treatment plants, and treatment with bio-health fertilizer was more effective in reducing the percentage and severity of infection of *aloe vera* plants. The percentages were 21.55% and 0.18, and the second level in reducing the percentage and severity of infection is the treatment with NPK nano-fertilizer watering.

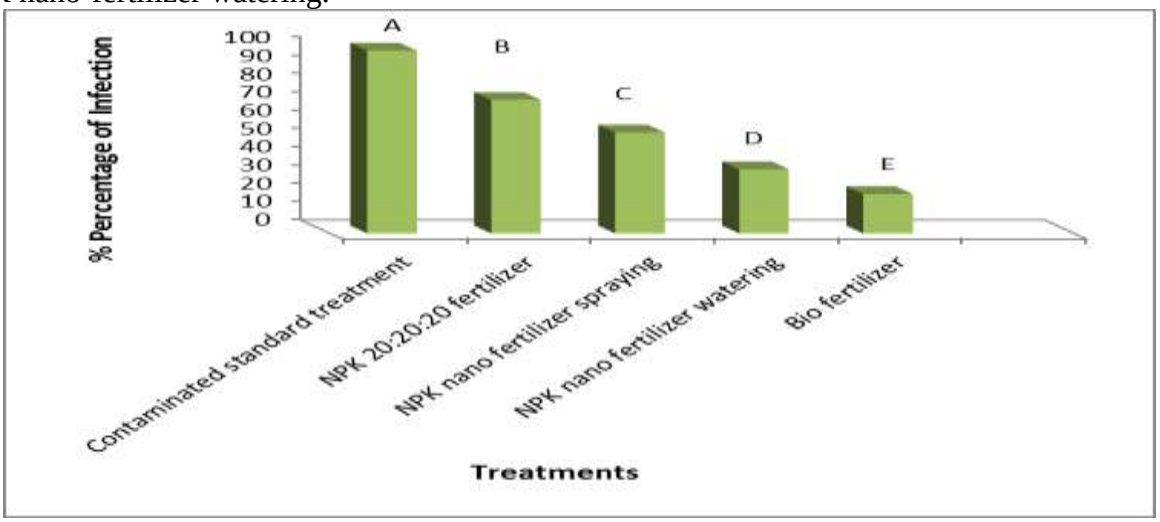

Figure (2): The effect of different fertilizers on the percentage of infection with *R. solani* on the root system of *aloe vera* plants.

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

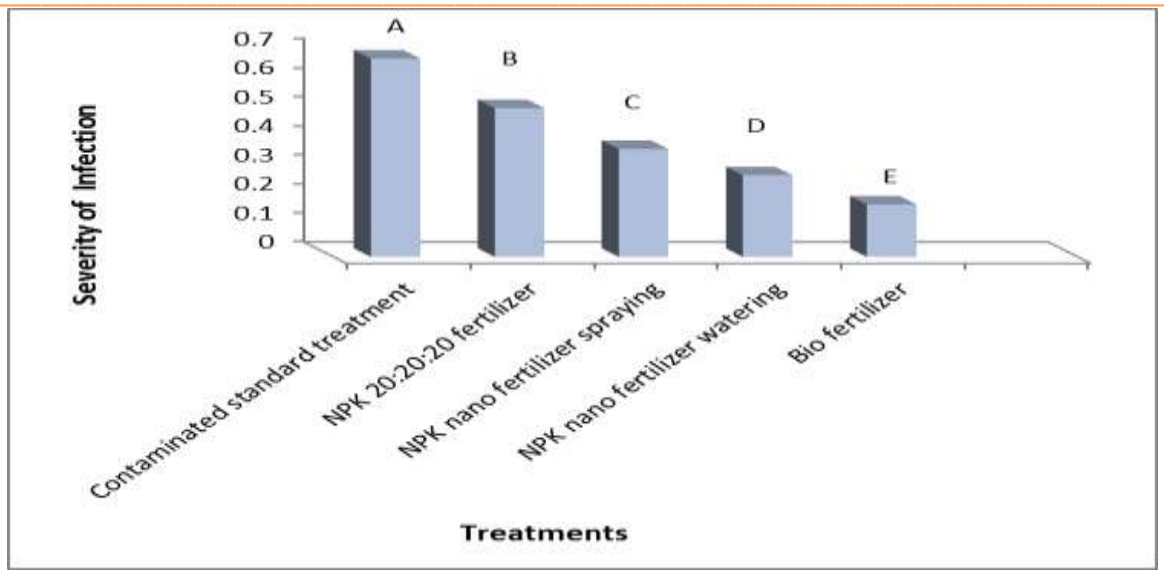

Figure (3): The effect of different fertilizers on the severity of infection with *R. solani* on the root system of *aloe vera* plants.

Effects of fertilizers On the percentage of infection and its severity in the aloe vera shoot system

The results of the statistical analysis presented in Figures (4,5) indicate that all fertilizer treatments reduced the percentage of infection and its severity with the pathogen *R.solani* with different rates on the shoot system compared to the contaminated standard treatment plants, and the most effective of these was the bio-fertilizer treatment, which was the most successful studied fertilizer treatment for reducing the pathogen's infection percentage and severity by 18.51 % and 0.12,which agrees with what Nega (2014) stated that bio fertilizer prevents and inhibits the growth of the fungi R.solani and Fusarium, and protects the plant against infections and increases the germination rate of Citrus aurantium seeds infected with R.solani.

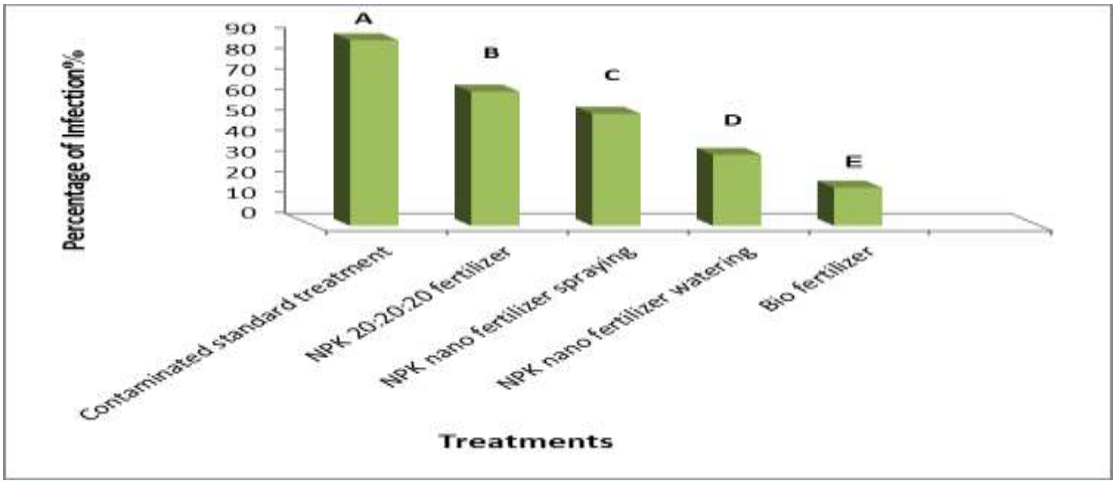

Figure (4): The effect of different fertilizers on the percentage of infection with *R. solani* on the shoot system of *aloe vera* plants.

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

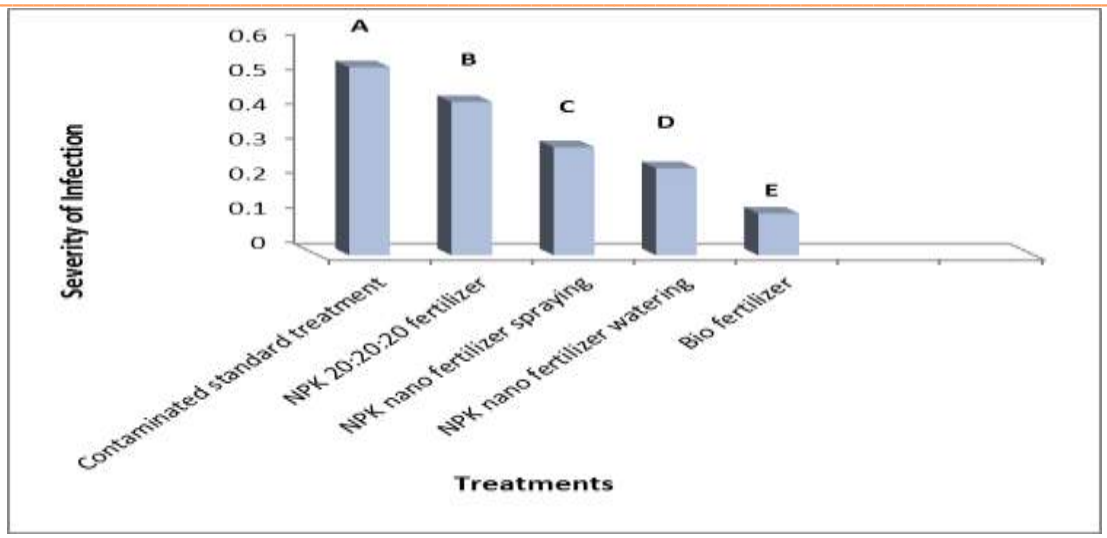

Figure (5): The effect of different fertilizers on the severity of infection with *R. solani* on the shoot system of *aloe vera* plants

This is consistent with what Faheed and Fattah (2008) stated, that the existence of bio-resistant *T. harzianum* and *B. subtilius* in the biofertilizer reduced the percentage of infection and its severity, as illustrated in Figures (4,5), where the highest percentage of infection and its severity were observed. Standard contaminated treatment was with the fungus *R. solani*, which is consistent with what El-Mohamedy et al. (2014) stated about the fungus Rhizoctonia's ability to secrete toxic substances and enzymes that break down cellulose and lignin, leading to the disintegration of cells and infecting plant parts above the soil surface, such as buds, leaves, and stems, resulting in the discoloration of leaves. As a result, the emergence of reddish-brown lesions in the crown.

The effect of different fertilizers on the *Aloe vera* growth features.

The effect of different fertilizers on the height, width, number of leaves, and offshoots of the *aloe vera* plants.

The results of the statistical analysis in table (1) indicate that there was a significant difference in the treatments that were used and their effects on the features of the infected *aloe vera* shoot system plant with the *R.solani*. The results showed that bio-fertilizer had the most effective results on features of height, width, number of leaves, and offshoots of the aloe vera, also there was a significant difference from all other fertilizer treatments. In addition to the standard treatments for the contaminated and non-contaminated plants, On the other hand, there are no significant differences between the two treatments; the NPK nano fertilizer spraying and watering on the plant height, the N.o of leaves and offshoots, as well as with the NPK 20:20:20 fertilizer on the N.o of offshoots by finding the correlation between the percentage and severity of infection on the shoot system of the infected plant with the *R.solani*. The treatment shows that there is an anticorrelation between them, which means the lower the percentage and severity of the infection, the higher the plant height, and the correlation coefficient was 0.67-and 0.61- respectively. Furthermore, it shows the negative anticorrelation between the percentage and severity of infection on the root system of the infected plant, which means the lower the percentage and severity of infection, the higher the plant height, and the correlation coefficient reached 0.66- and 0.68- respectively.

Indeed, the correlation coefficient shows a negative anticorrelation , which means the lower the percentage and severity of infection with the *R.solani* on the shoot system, the higher the width of the plant, and the correlation coefficient reached 0.78- and 0.71- respectively. The increase of significant width of the aloe vera plants in different treatments are due to the decrease in the percentage and severity of infection with the pathogenic on the root system, and this shows the negative anticorrelation between the percentage, severity of infection, and the plant width with a correlation coefficient of 0.77- and 0.78- respectively.

The table shows the significant increase in the number of *aloe vera* leaves that were treated with different fertilizer treatments compared with the contaminated ones, so this shows the correlation with the decrease in the percentage and severity of infection *R.solani* on the shoot and root system. This also shows the anticorrelation between the percentage and severity of infection and the number of plant leaves with a

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

correlation coefficient of 0.63- and 0.71- on the shoot system and 0.73- and 0.67- on the root system respectively. The increase in the number of offshoots for the *aloe vera*, which is treated with different fertilizer treatments compared with the contaminated one, and this is related to the decrease in the percentage and severity of infection on the root and shoot systems. This also conforms to the existence of an anticorrelation between them, with a correlation coefficient of 0.72- and 0.75- on the shoot system and 0.75- and 0.75- on the root system respectively.

Table (1) Effects of various treatments on *aloe vera* plant growth features.

features				
treatments	plant hight (cm)	width(cm)	Leaves N.O	Offshoots N.O
Contaminated standard treatment	D 9.11	D 7.33	D8.00	D 1.33
Standard treatment not Contaminated	C15.56	C14.44	C11.33	C 2.67
NPK 20:20:20 fertilizer	B17.56	B16.78	C11.67	B C 3.33
Bio fertilizer	A19.11	A 19.11	A 17.33	A 4.67
NPK nano fertilizer spraying	C16.22	C14.78	B15.00	A B 4.00
NPK nano fertilizer watering	C16.11	B 17.44	B 15.67	B 3.67

*averages with similar letters for each column do not differ significantly, according to Duncan's multiple range test, at a 5% probability level.

The effect of different treatments on the weight of wet leaves, the wet and dry peels , and the *aloe vera* gel

The results of the statistical analysis in table (2) indicate that there are no significant differences in weight of wet leaves between the bio-fertilizer and nano-fertilizer in spray treatments; there are also no significant differences in the nano-fertilizer in both spray and watering treatments; as well as there are no significant differences between the two NPK 20:20:20 and the uncontaminated standard treatments. These results show that there is a negative anticorrelation , which means the lower the percentage and severity of the infection *R.solani* for both shoot and root systems, the higher the weight of wet leaves becomes, with a correlation coefficient of 0.78- and 0.75- on the shoot system, also 0.80- and 0.77- with the root system respectively. Otherwise, there is a significant difference between the types of fertilizers that were used in the experiment and the standard of positive treatment. The positive treatment has a good impact on the weight of *aloe vera* wet peels. On the other hand, in the infected treatments, the weight of wet peels reached 4.67g. This shows an anticorrelation between the percentage and severity of infection on the shoot and root systems, which means the lower the percentage and severity of the infection with the pathogenic, the higher the weight of *aloe vera* wet peels becomes, with a correlation coefficient of 0.74- for the shoot system, also 0.78- and 0.78- for the root system respectively.

The bio-fertilizer has the most effect in all treatments. It has a beneficial effect on the weight of the *aloe vera* gel and the dry peels, with a level of 13.56g and 6.07g, also with significant differences in all treatments. The second fertilizer is the nano-fertilizer in both the spray and watering treatments, and it also has a significant difference in the weight of the gel and the peels. Actually, this shows that the decrease in the percentage and severity of infection *R.solani* on the root and shoot system is the reason for the significant increase in the weight of the gel and the peels. This shows that there is a negative anticorrelation between each of the percentage and severity of infection and the weight of the gel and dry peels; also, the correlation coefficient with the gel reached 0.68- and 0.66- with the shoot system, and also 0.73- and 068-

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

on the root system respectively. where the correlation coefficient with the dry peels reached to 0.78- and 0.73- with the shoot system, and also 0.78- and 0.67- with the root system respectively.

Table (2) Effects of various treatments on *aloe vera* plant growth features.

features				
treatments	Wet leaf weight (gm)	wet peels weight (gm)	Gel weight (gm)	Dry peel weight (gm)
Contaminated standard treatment	E 10. 00	B4.67	D5.67	D1.61
Standard treatment	D22.33	A 12.33	C10.00	C3.21
NPK 20:20:20 fertilizer	C D23.33	A 12.89	C10.44	C3.20
Bio fertilizer	A26.67	A13.11	A13.56	A6.07
NPK nano fertilizer spraying	A B 25.22	A 13.11	B12.11	B4.100
NPK nano fertilizer watering	B C 24.67	A 12.33	B12.33	B C3.63

*averages with similar letters for each column do not differ significantly, according to Duncan's multiple range test, at a 5% probability level.

The effect of different treatments on the wet and dry weight of the aloe vera shoot and root systems.

The results in table(3) show that fungal and bacterial treatment interference are the most effective treatments on the weight of wet and dry of the shoot and root systems as well as with the level of 134.56g and 63.98g, also 21.00g and 4.29g respectively with a significant difference from all treatments. The second one is the nano-NPK spraying and watering with the wet weight of the shoot system. On the other hand, there is no significant difference between the bio-interference and the nano-NPK sprayed treatments with the wet weight of the shoot system. Otherwise, there is a significant difference between the NPK 20:20:20 fertilizer treatment and the standard of positive treatment in the wet and dry weight in the shoot and the root systems. In addition, the infected treatment was less wet and dry weight in the shoot and the root systems.

Table (3) Effects of various treatments on aloe vera wet weight in the shoot and root systems

features	
Root system (gm)	Shoot system(gm)

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

Treatments	Wet weight	Dry weight	Wet weight	Dry weight
Contaminated standard treatment	D 81.67	E 34.16	E 5.67	E1.00
Standard treatment not Contaminated	C108.44	D44.56	D10.33	D 2.40
NPK 20:20:20 fertilizer	C109.44	D 45.10	D11.00	D2.42
Bio fertilizer	A134.56	A 63.98	A21.00	A4.29
NPK nano fertilizer spraying	B 121.89	A 56.33	C14.11	B 3.51
NPK nano fertilizer watering	B 121.78	C60.78	B 17.33	C2.90

*averages with similar letters for each column do not differ significantly, according to Duncan's multiple range test, at a 5% probability level

The significant increase in the wet weight of the shoot and root system for all the treatments included in the experiment in various quantities compared to the standard contaminated treatment with the pathogen may be due to the negative anticorrelation between the percentage of infection and its severity with the pathogen on the shoot and root systems and the increase in the wet and dry weight of infected aloe vera plants. That confirms the results and the existence of a correlation. as measured by a correlation coefficient and its value with the fungus *R.solani* -0.70, -0.69, -0.71, and -0.72, respectively for the wet weight of the shoot system.

While the correlation coefficient of the dry weight of the shoot system was -0.60 , -0.59 , -0.64 , -0.69 . The negative anticorrelation was noticed in the increase of the wet weight when decreasing the percentage of infection and its severity, and the correlation coefficient of the wet root system was -0.74 , -0.66 , -0.71 , -0.72 respectively. The correlation coefficient of the dry root system was -0.64 , -0.57 , -0.64 , -0.62 respectively.

Effects of various treatments on *aloe vera* leaf dimensions, thickness, and width also on Chlorophyll content and root length .

According to the results of the statistical analysis presented in Table 4, the effect of various fertilizer treatments, as well as the positive and negative standard treatments, on the various features of *aloe vera* plants infected with the pathogen *R.solani* is obvious.

In each of the leaf dimensions, thickness, and width, as well as chlorophyll content and root length, the biological fertilizer treatment was observed to be the most effective with the following amounts (4.13 cm^2 , 5.24 mm , 5.63 cm , 13.3 cm , 47.55 cm) respectively, where In terms of leaf dimensions, there was no significant difference between bio-fertilizer and NPK 20:20:20 fertilizer treatments where it was 3.73 cm2.

There was also no significant difference between NPK nano fertilizer spraying and watering, The negative correlation coefficients of -0.067, -0.69, -0.74 and -0.75 between the percentage of infection and the severity of Rhizoctonia rot root disease on the shoot and root system and leaf dimensions provide additional evidence that the significant increase in leaf dimensions observed across the various fertilizer treatments and the positive standard treatment is a direct result of the reduced percentage of infection and its severity.

In terms of their effect on the thickness of the *aloe vera* leaf after treatment with bio-fertilizer, the other fertilizer treatments ranked second, with a significant difference from the standard treatment infected with

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

the fungus. The table also indicated that there was no statistically significant difference between the nano-NPK sprayed treatment, the NPK 20:20:20 treatment, and the positive standard treatment in terms of the *aloe vera* leaf width. These results demonstrate the existence of a negative anticorrelation between the percentage of infection and its severity and the thickness and width of *aloe vera* leaves (3.37 , 3.37 and 3.30). And the correlation coefficient between leaf thickness and aloe vera plant was -0.69, -0.60, -0.68 and -0.6 respectively 6, while the correlation coefficient for leaf width was -0.76, -0.67, -0.73 and -0.74 respectively.

Concerning the chlorophyll content in the leaves of *aloe vera* plants, it was determined that there was no significant difference between the bio-fertilizer and the NPK nano fertilizer watering with 13.33 CCI and 12.56 CCI respectively, and that there was also no significant difference between the two treatments of the NPK nano fertilizer spraying and the NPK 20:20:20 fertilizer in the positive standard treatment.

And that the two treatments of nano-NPK spraying and watering and the treatment of NPK 20:20:20 fertilizer with no significant difference between them are one of the best treatments included in the experiment for their effect on the root length of *aloe vera* plants after treatment with bio-fertilizer; there was a difference from the positive and negative standard treatments, either in the significant increase of fertilizer treatments and the standard treatment or in the significant decrease of fertilizer treatments and the standard treatment. The positive comparison with the treatment contaminated with the pathogenic fungus *R. solani* in the chlorophyll content and root length of *aloe vera* plants is due to the low percentage of infection and its severity on the shoot and root system; this confirms the negative correlation coefficient between infection with the pathogen and the chlorophyll content in *aloe vera* leaves with correlation coefficients of -0.66 and -0.57, -0.64, -0.65 respectively, and, -0.62 , -0.60 , -0.67 , -0.69 respectively. The results supported Wu (2003) and Haseeb's (2020) statements that the addition of nano-NPK stimulates shoot growth and photosynthetic processes.

Table (4) Effects of various treatments on *aloe vera* plant growth features.

features					
treatments	Leaf dimensions cm^2	Leaf thickness (mm)	Leaf width (cm)	Chlorophyll content CCI	Root length (cm)
Contaminated standard treatment	C 1.33	D 2.40	D 1.70	D 3.27	D 21.11
Standard treatment not Contaminated	B 3.13	B 4.17	C 3.30	C 8.20	C 41.44
NPK 20:20:20 fertilizer	A B 3.73	B 4.27	C 3.73	C 9.67	B 42.44
Bio fertilizer	A 4.13	A 5.24	A 5.63	A 13.33	A 47.55

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

NPK nano fertilizer spraying	B 3.37	B 4.57	C 3.37	C 11.44	B 43.77
NPK nano fertilizer watering	B 3.57	B 4.60	B 4.37	A B 12.56	B 45

*averages with similar letters for each column do not differ significantly, according to Duncan's multiple range test, at a 5% probability level

References:

1. Al-Nua'imi, Jabbar Hassan (2010). "Treatment with fruit trees, and forests". Al-Hawraa publishing, Baghdad, Iraq. p.541, book.
2. Al-Shaheen, Farah Ali, Ibtihaj Handal Al-Tamimi and Fatima Ali Al-Asadi.(2018). "Evaluating the efficiency of bio-fertilization bio health in the vegetative growth and roots of three types of aloe plant", Thi-Qar University Journal of Agricultural Research, 7 (1): 33-56.
3. Haseeb, Sawsan Tariq. (2020). Effect of nano fertilizer and calsium silicate on some of the characteristics of vegetative of Gerbera Jamesonii L. and powdery mildew percentage, Master Thesis/ College of Agriculture, University of Kirkuk.
4. Panovska, T. K., & Kulevanova, S. (2005). Effect of some Teucrium species (Lamiaceae) on lipid peroxidation in rat liver microsomes. Fresenius Environmental Bulletin, 14(10), 957-959.
5. Rajasekaran, S., Ravi, K., Sivagnanam, K., & Subramanian, S. (2006). Beneficial effects of Aloe vera leaf gel extract on lipid profile status in rats with streptozotocin diabetes. Clinical and Experimental Pharmacology and Physiology, 33(3), 232-237
6. Nazar, R., Iqbal, N., Syeed, S., & Khan, N. A. (2011). Salicylic acid alleviates decreases in photosynthesis under salt stress by enhancing nitrogen and sulfur assimilation and antioxidant metabolism differentially in two mungbean cultivars. Journal of plant physiology, 168(8), 807-815.
7. Tungala, A., Ajay, J. Y., Gajula, P. K., Dinesh, J., & Kumar, J. D. (2011). Conversion of malic acid in to lactic acid in aloevera by using lactic acid bacteria. Journal of Phytology, 3(3), 1-11.
8. Rajeswari, R., Umadevi, M., Rahale, C. S., Pushpa, R., Selvavenkadesh, S., Kumar, K. S., & Bhowmik, D. (2012). Aloe vera: the miracle plant its medicinal and traditional uses in India. Journal of Pharmacognosy and Phytochemistry, 1(4), 118-124.
9. Park, J. Y., Lee, Y. J., Jun, K. W., Baeg, J. O., & Yim, D. J. (2006). Chemical synthesis and characterization of highly oil dispersed MgO nanoparticles. Journal of Industrial and engineering chemistry, 12(6), 882-887.
10. Pankaj, P. (2013). Patient-specific modelling of bone and bone-implant systems: the challenges. International journal for numerical methods in biomedical engineering, 29(2), 233-249.
11. Pandit, A. V., Kumar, A., Rao, G. S., Kedarnath, C., Srihari, R., & Ranade, V. V. (2012). Modeling of liquid propellant combustion chamber. Chemical engineering journal, 207, 151-166
12. Manvitha, K., & Bidya, B. (2014). Aloe vera: a wonder plant its history, cultivation and medicinal uses. Journal of Pharmacognosy and Phytochemistry, 2(5), 85-88.
13. Sitara, U., Hassan, N., & Naseem, J. (2011). Antifungal activity of Aloe vera gel against plant pathogenic fungi. Pakistan Journal of Botany, 43(4), 2231-2233.
14. Avasthi, S., Gautam, A. K., & Bhadauria, R. (2011). First report of anthracnose disease of Aloe vera caused by Colletotrichum gloeosporioides. Journal of Research in Biology, 5, 408-410.
15. Avasthi, S., Gautam, A. K., & Bhadauria, R. (2018). First report of leaf spot disease of Aloe vera caused by Fusarium proliferatum in India. Journal of Plant Protection Research. 7(1), 1-9.
16. Shaker, N., Togelius, J., & Nelson, M. J. (2016). Procedural content generation in games Switzerland: Springer International Publishing,36(3),319 – 427.

ISSN NO: 2771-8840
Date of Publication: 28-08-2022

17. Goffin, J. M., Pankaj, P., Simpson, A. H. R. W., Seil, R., & Gerich, T. G. (2013). Does bone compaction around the helical blade of a proximal femoral nail anti-rotation (PFNA) decrease the risk of cut-out? A subject-specific computational study. Bone & joint research, 2(5), 79-83Perves, J. P. (2016). The multi-annual energy programme (PPE): the headlong rush,4(6),62 – 65.
18. Sahoo, R. K., Bhardwaj, D., & Tuteja, N. (2013). Biofertilizers: a sustainable eco-friendly agricultural approach to crop improvement. In Plant acclimation to environmental stress (pp. 403-432). Springer, New York, NY.
19. McKinney, H. H. (1923). influence of soil temperature and moisture on infection of wheat seedlings by helmin. Journal of agricultural research, 26, 195.
20. Mishra, S., Keswani, C., Abhilash, P. C., Fraceto, L. F., & Singh, H. B. (2017). Integrated approach of agri-nanotechnology: challenges and future trends. frontiers in Plant Science, 8, 471.plications. Drug discovery today, 22(12), 1825-1834.
21. Patton, L. (1984). Photosynthesis and growth of willow used for short rotation (Doctoral dissertation, Ph. D. Thesis submitted to the univ. of Dublin (Trinity College). 1990. Studies of variation in primary productivity growth and morphology in relation to the selective improvement of broad-leaved trees species. Ph. D. Thesis submitted to the National Univ. Irland).
22. Parmeter Jr, J. R., & Whitney, H. S. (1970). Taxonomy and nomenclature of the imperfect state (pp. 7-19). University of California Press, Berkeley.
23. Perves, J. P. (2016). The multi-annual energy programme (PPE): the headlong rush,4(6),62 – 65.
24. Nega, A. (2014). Review on concepts in biological control of plant pathogens. Journal of Biology, Agriculture and Healthcare, 4(27), 33-54.
25. Faheed, F. A., & Fattah, Z. A. (2008). Effect of Chlorella vulgaris as bio-fertilizer on growth parameters and metabolic aspects of lettuce plant. Journal of Agriculture and Social Sciences (Pakistan).
26. El-Mohamedy, R. S., Jabnoun-Khiareddine, H., & Daami-Remadi, M. (2014). Control of root rot diseases of tomato plants caused by Fusarium solani, Rhizoctonia solani and Sclerotium rolfsii using different chemical plant resistance inducers. Tunisian Journal of Plant Protection, 9(1), 56.
27. Wu, S. I. (2003). The relationship between consumer characteristics and attitude toward online shopping. Marketing intelligence & planning.
28. Biber, D. (2007). Discourse on the move: Using corpus analysis to describe discourse structure (Vol. 28). John Benjamins Publishing.