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# EFFECT OF PATHOGENIC FUNGUS *RHIZOCTONIA SOLANI* AND HIGH TEMPERATURE ON CUCUMBER AND SNAKE CUCUMBER PLANTS AND COMPARISON BETWEEN THEM

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***Abstract***

*High temperatures especially in greenhouses work on stress plants, this stress and damage increased in the presence of pathogenic soil fungi. Rhizoctonia solani is consider as an endemic fungus in the soil and causes significant problems for horticultural crops in greenhouses. This study was conducted to compare between cucumber and snake cucumber in terms of infection of R.solani and the impact of high temperatures where it was studied and compared the speed of germination, germination rate, seedling death and infection severity. The results showed that the cucumber was superior to snake cucumber at the rate of germination, where the seedling emergence was 62 hours after planting, while the seedling emergence for snake cucumber was 89 hours after planting. As for the germination percentage in soil contaminated with R.solani of cucumber and snake cucumber, were 40% and 26.66%, respectively. For the seedling death results were 33% and 25% in cucumber and snake cucumber plants respectively. Growth parameters were measured. The results showed that there were significant differences between them in growth parameters.*

***Key words****: cucumber, Rhizoctonia solani, snake cucumber, temperature.*

## INTRODUCTION

Cucumber is one of the most important cultivated greenhouse crops. Most varieties are female hybrid cultivars, but monoic cultivars are still in use in some South East European countries.

Cucumber cultivation – as for other fast-growing vegetables – is characterized by technologies designed to increase intensive production. Cultural practices aim to provide an appropriate root medium, balanced root/leaf growth, balanced source/sink development, and a good harvesting rate of high-quality fruits. The most important growing practices are microclimate control, fertigation and training.

Cucumber is very sensitive to both abiotic and biotic stresses, and serious problems can arise in the case of inappropriate crop management. Integrated pest management provides various approaches for smallholders (Gruda et al., 2017).

Cucumber is well planting and growing in tropical and subtropical regions, also grown in greenhouses or under plastic structure in cooler areas and it is most common vegetable species grown in greenhouses (Erper and Özkoç, 2002). Cucumber is one of many susceptible crops to damping-off and root rot disease caused by *Rhizoctonia solani* (Safaa et al., 2013).

*R.solani* is one of the most important pathogens of plants and colonies in the soil. It affects different plant families causing seedling or root decomposition.

The diseases caused by *R. solani* spread throughout the world and cause losses for most plants, as well as the most economically important root diseases of cucumber with broad host range that includes most annual and many perennial plants.

*R. solani* affects a different parts of plant from roots, stems and rhezumat in the soil, and even leaves touching the surface of soil contaminated with fungus, and this fungus is one of the main causes of seedlings fall, attacking the seeds of different plant families in the bud causing rot and cause seedlings death quickly before they emerge from the soil surface.

The fungus is attracted to the plant through chemical catalysts caused by the activity of the plant's growing cells or by the decomposition of the plant residues, as a result of the attraction process, the hypha become contact with the

plant and then adhere to the outer surface, penetrate the root cells and extend between the skin cells or penetrate the inner cellular wall, because of this the tissue become brown, and this is due to that the fungus secrete toxic substances and enzymes that analyzed cellulose and lacenin, leading to cell disintegration (Michael et al., 1981).

Christine et al., (1981) noted that the development of the infection is rapid, as the fungus kills the infected seedlings within six days of the onset of infection, while (Jhooty and Grover, 1971) reported that the highest percentage of infection and the most severe cause of the fungus on agricultural crops is in the first and second weeks of agriculture, and resistance increases with age.

*R. solani* is found in the upper layers of the soil but not in the surface and attacks the seedlings. The pathogen remains in the dead roots as a mycelia with thickening walls. When cultivating the plants, and when humidity and temperature are available mycelia touches the growth root and then penetrates the root, pathogen enters roots and kill the root tissue, the crust and the skin (Paulitz et al., 2010). Also *R. solani* produce many enzymes and pathogen toxin such as phenyl acetic acid and its derivatives (Iacobellis and DeVay, 1987), which play an important role in the pathogenic ability and it is responsible for the appearance of symptoms of fungi, as well as for many carbohydrate compounds containing glucose or mannose in their composition (Vidhyasekaran, 1997).

Some studies have indicated that pathogenic fungi infected the host due to the production of cell membrane enzymes including laccases, cutinases, pectinases, and cellulase. The enzymes that analyzed pectin are one of the major enzymes associated with pathogenesis (Isshiki et al., 2001).

*R.solani* is one of the fastest pathogens killed the host, laboratory experiments have shown that a group of enzymes produced by fungi help to break up cell walls such as pectinase, methyl esterase pectin, cellulase and phosphatase (Murphy et al., 1984; Dillard, 1987).

When the hypha is connected to the host, it grows on the surface of the host's skin. At this stage, it begins to form adhesion organs or to form a hypha branches with T-type and infection cushion, after that, the penetration occurs as a result of the secretion of the pectin-analyzed enzymes this take about 10-12 hours from plant contact stage (Christon, 1962; Armentrout and Downer, 1987).

Temperature is one of the main factors playing an important role in fungi growth and spread, the effect of temperature on the growth of *R.solani* showed that the growth rate increased as temperature increased (Antonio et al., 2013).

The objective of this work is study the effect of *R. solani* and high temperature on cucumber and snake cucumber plants and comparison between them by measuring some growth parameters.

## MATERIALS AND METHODS

The experiment was held at the University of Agricultural Sciences and Veterinary Medicine in Bucharest on 15-06-2018. *R.solani*: DSM 63002 was obtained from institute of research and development of plant protection, Bucharest. Cucumber type; Artist F1 and snake cucumber was obtained from Iraq.

Laboratory experiment was conducted to determine the speed, germination rate and seedling of each cucumber and snake cucumber and in four replicates.

The peat moss was sterilized at $121^0$C and atmospheric pressure of 15 lbs. / Ang² for an hour and for two consecutive days and then placed in sterilized pots with capacity of 500 grams.

We made holes with 17 depth x 24 diameter, the weight of soil with peat moss were 3 kg, *R. solani* was added with 1% to the treatments and then irrigated pots daily, for three days before planting. After that 10 seeds were put in each pot, the germination speed was measured and after 10 and 15 days the germination rate and seedling death were measured respectively according to the following equations (Mickenny, 1923; AL-Waily, 1988).

- % germination = (Number of germinated seeds)/ (Number of total seeds) x 100
- % seedlings death = (Number of dead seedlings)/ (Number of germinated seedlings) x 100

The treatment of cucumber and snake cucumber were as shown in table 1.

Table 1. The treatment of cucumber and snake cucumber plants in pots in laboratory

| Treatments | |
|---|---|
| Cucumber + *R.solani* | Snake cucumber + *R.solani* |
| Cucumber control | Snake cucumber control |

While the field experiment was conducted in greenhouse cultivation of seedlings of cucumber and snake cucumber plants which divided in two parts, first part was contaminated with *R.solani* while the second part consider as control (table 1), after that growth parameters, such as length and weight of the plant, chlorophyll which measured by OPTI-SCIENCES CCM-200 plus device, phosphorus was estimated depending on (Murphy and Riley, 1962; Cresser and Parsons, 1979). Nitrogen which measured according to (Bremner and Edwards, 1965), photosynthesis and respiration determined by ADC Bio Scientific Ltd. in (31-36) $^0$C and light intensity (1200-1500) and high temperature tolerance were also measured.

## RESULTS AND DISCUSSIONS

Our results obtained from the experiments made and presented in Table 2, show that the highest percentage of germination was in the case of cucumber control and snake cucumber control, reaching 95.00% and 90.00%, respectively, while the lowest percentage of germination due to the impact of pathogenic fungus *R.solani* being in the case of snake cucumber with *R.solani* which reached 26.66%, following the cucumber with *R.solani*, which was 40.00%.

While our results, referring to dead seedlings, presented in Table 2 also showed the highest percentage of dead seedlings relative to *R.solani* treatment with cucumber which reached 33.00%, and snake cucumber + *R.solani* reaching 25.00%.

Table 2. The effect of pathogenic fungus *R.solani* in germination and dead seedlings in cucumber and snake cucumber plant

| Treatments | Germination ratio (%) | Seedlings death ratio (%) |
|---|---|---|
| Cucumber + *R.solani* | 40.00 | 33.00 |
| Cucumber control | 95.00 | 0.00 |
| Snake cucumber + *R.solani* | 26.66 | 25.00 |
| Snake cucumber control | 90.00 | 0.00 |
| **L.S.D 0.05** | **4.61** | **9.23** |

The most a small ratio of dead seedlings was in the case of cucumber and snake control reached 0.0%.

Our results for the length of plant in Table 3 show the highest length was in snake cucumber control which reached to 230.00 cm in comparison snake cucumber + *R.solani* treatment which reached to 140.00 cm with while the lowest was in cucumber + *R.solani* treatment which reached to 124.00 cm while cucumber control was 168.00 cm.

The weight of plant in snake cucumber control was the highest which was 61.00 g followed by cucumber control which was 52.00 g and snake cucumber + *R.solani* 38.00 g the lowest weight was in cucumber + *R.solani* which reached to 32.00 g as shown in Table 3.

The results of chlorophyll levels are shown in table 3, showed the highest level of chlorophyll in cucumber control which was 42.00 µmol $m^{-2}$ followed by snake cucumber control which reached to 39.45 µmol $m^{-2}$ and cucumber + *R.solani* which was 35.12 µmol $m^{-2}$ compared with the lowest level which was 30.17 µmol $m^{-2}$ in snake cucumber + *R.solani*. The nitrogen levels was high in cucumber control which reached to 2.98 followed by snake cucumber control which was 2.79 and snake cucumber + *R.solani* which reached to 2.35 while the lowest level was 2.20 in cucumber + *R.solani*. The highest phosphor level was 0.46 in cucumber control followed by snake cucumber control which reached to 0.41 and cucumber + *R.solani* which reached to 0.31 and the lowest was in snake cucumber + *R.solani* which reached to 0.29 as shown in Table 3.

The photosynthesis results show the highest levels was in snake cucumber control treatment which reached to 15.36 µmol $m^{-2}$ $s^{-1}$ and in cucumber control treatment which reached to 13.92 µmol $m^{-2}$ $s^{-1}$ followed by cucumber + *R. solani* treatment which was 5.79 µmol $m^{-2}$ $s^{-1}$ compared to the lowest level in snake cucumber + *R. solani* treatment which was 4.81 µmol $m^{-2}$ $s^{-1}$.

The respiration was in highest levels in cucumber control which was 5.83 mmol $m^{-2}$ $s^{-1}$ followed by snake cucumber control treatment which reached to 5.42 mmol $m^{-2}$ $s^{-1}$ and snake cucumber + *R. solani* treatment which was 4.02 mmol $m^{-2}$ $s^{-1}$ while the lowest level was in

cucumber + *R. solani* treatment which reached to 3.77 mmol $m^{-2}$ $s^{-1}$.

Table 3. The effect of *R.solani* in plant indicators in cucumber and snake cucumber treatment

| Treatments | L(cm) | W(g) | CHL | N% | P% | PHYT | RES |
|---|---|---|---|---|---|---|---|
| **Cucumber + *R.solani*** | 124.00 | 32.00 | 35.12 | 2.20 | 0.31 | 5.79 | 3.77 |
| **Cucumber control** | 168.00 | 52.00 | 42.00 | 2.98 | 0.46 | 13.92 | 5.83 |
| **Snake cucumber + *R.solani*** | 140.00 | 38.00 | 30.17 | 2.35 | 0.29 | 4.81 | 4.02 |
| **Snake cucumber control** | 230.00 | 61.00 | 39.45 | 2.79 | 0.41 | 15.36 | 5.42 |
| **L.S.D 0.05** | **2.074** | **4.15** | **3.48** | **0.172** | **0.04** | **0.92** | **0.43** |

***L; length of plant, W; weight of plant, CHL; chlorophyll, N; nitrogen, P; phosphor, PHYT; photosynthesis and RES; respiration.**

Since temperature considered as one of the main factors playing an important role in fungi growth and spread, the effect of temperature on the growth of *R.solani* showed that the growth rate increased as temperature increased. Also the high temperature and infection with *R. solani* can play a dual role in affection of plant growth, our results of the effect of high temperature on cucumber and snake cucumber plant showed that the high temperature ($\leq 55^0$ C) affects cucumber more than snake cucumber and this effect increased when the plant infected with *R.solani* fungus.

Figure 1. Speed of germination


Figure 2. Stage of infection


Figure 3. Cucumber and snake cucumber plants

*R. solani* is the most versatile cause of the most common disease of any other fungal pathogen, affecting more than 142 different plant species of 125 plant categories (Lucas et al., 1985; Ogoshi, 1996). The symptoms of this fungus vary depending on plant populations, age of plants and surrounding environmental conditions. It is found that it affects seeds, roots, stems, tubers, caterpillars and all plant parts that grow in or on the soil, causing diseases of seed rot, seedling and root rot (Agrios, 2005). Our study results showed the effective role of *R.solani* which is one of the most important pathogens of plants and colonies in the soil on the germination and seedling death and other plant indictor. *R.solani* affects different plant families causing seedling or root decomposition. The diseases caused by *R.solani* spread throughout the world and cause losses for most annual and perennial plants. The symptoms of these diseases vary depending on the type of crop, its growth stage, and the environmental conditions surrounding the plant prevalent in the region (Jarjis et al., 1992).

*R. solani* affects a different parts of plant from roots, stems and rhezumat in the soil, and even leaves touching the surface of soil contaminated with fungus, and this fungus is one of the main causes of seedlings fall, attacking the seeds of different plant families in the bud causing rot and cause seedlings death quickly before they emerge from the soil surface.

The fungus is attracted to the plant through chemical catalysts caused by the activity of the plant's growing cells or by the decomposition

of the plant residues and this appear in our results which *R.solani* effects on length, weight of plant, levels of chlorophyll, nitrogen, phosphorus, photosynthesis, respiration (Michael et al., 1981). *R.solani* was one of the fastest pathogens which killed its host.

This feature was studied in a laboratory and found to have a group of enzymes related to fungi that help decompose cell walls such as pectinase, pectin methyledterase, cellulase, phosphatase (Murphy et al., 1984; Dillard, 1987). Damping-off of plant seedlings caused by *R. solani* is a common fungal disease causing severe seedlings death.

Cultural and biological control are the only tools in organic crops to manage this disease (Mohamed et al., 2015).

## CONCLUSIONS

*R. solani* is considered an endemic fungus in the soil and causes significant problems for horticultural crops in greenhouses.

Our results show this effect through the negative alterations of germination rate and seedling death, also the decreasing of some plant indictor levels such as chlorophyll, nitrogen, phosphorus, photosynthesis and respiration.

Since temperature is one of the factors playing an important role in plants and fungi growth and spread, our results reflected the effect high temperature in experimental plants of affects cucumber more than snake cucumber and this effect increased when the plant infected with *R. solani* fungus.

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