International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

http://ijpsat.ijsht-journals.org
Vol. 26 No. 2 May 2021, pp.184-192

# *Complex Influence Of Soil Solarization And Green Maneuvering On Wilt-Infested Fields On Its Biogenicity*

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**Abstract – It was found that during the cotton fields solarization infected with wilt in the summer period after harvesting wheat, due to the high temperatures formed under film, the wilt pathogens in the soil, as well as the total number of microorganisms, are inhibited. To restore total number of microorganisms, the plowing of the chopped green mustard mass under the ploughland was shown to be more effective.**

**Keywords – Cotton Cultivation, Microsclerotia Germination, Microbiological Potential.**

## I. INTRODUCTION

The causative agent of wilt is constantly accumulating in soil and not use in scientifically grounded anti-wilt crop rotation farms but contributes to new cotton varieties defeat, due to the high adaptive pathogens ability to new zoned varieties. Highly virulent spread and aggressive pathogens forms, which constantly accumulate in the soil during the permanent cotton cultivation, also contributes to the increase in the damage to varieties by wilt.

Therefore, the effective measures development to combat soil pathogens that cause wilt in cotton and other crops has been, is and will be a very urgent problem for modern agriculture, and an integral part of the program to ensure food security in Uzbekistan.

In the field, the microsclerotia germination was noted at the beginning of April, when the soil temperature during the day was not lower than $+7^0$C. Apparently, at this time, the parasite introduction into cotton begins, since the first diseased plants appear in May in the 3-4 true leaves phase. The microsclerotia growth stops in early November, when the average daily temperature is below $+ 7^0$C.

The optimum temperature for microsclerotia germination, fungi growth and development is $+24\text{-}26^0$C, humidity is 60-70%. The pathogen overwinters on infected plant debris and in the soil (Soloveva, Poyarkova, 1940).

As N.S. Mirpulatov pointed out (1973), mainly soil pathogens are found in the cotton roots rhizosphere at 5-25 cm depth. The favorable soil temperature for wilt pathogens development is 24-280C, over 300C is destructive.

We (Marupov, 1993б) found that the V. dahliae microsclerotia viability significantly decreases depending on the increase in depth (0-100 cm) and their presence period (365 days) in the soil.

N. S. Mirpulatova (1972) found that the occurrence depth of most V.dahliae infection in the topsoil and its dependence on technology prior to sowing soil preparation. On typical non-saline gray soils of long-term irrigation, during the cotton cultivation

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in the ploughland, most of the V.dahliae infection is located at 10-30 cm depth, and in the spring plowing - in the 0–20 cm horizon. The author points out the need to take these biological factors into account when developing anti-force measures.

Considering the causative agents bioecology of wilt pathogens, their eradication in the arable soil horizon, creating a high temperature is one of the important ways to combat soil pathogens.

The high soil solarization efficiency in the fight against soil pathogens of cotton, vegetables and other crops was proved by Israeli and American scientists (KennethN. andJ. Katan (eds.), 1972; Grinstein, A. and J. Katan, 1979; Katan, J. and J.E. DeVay (eds.), 1991; Gamliel, A. and Katan, J. (eds.), 2012). As the authors point out, when using films with 0,038-0,050 mm size, the soil temperature at 5-10 cm depth reaches 42-550C and at 45 cm depth 32-370C.

When using black and double layers of white films, the soil temperature rises. They found that soil pathogens die in this case.

Our (Marupov, Turamuratova, 2017) studies also revealed that soil pathogens die during soil solarization, but it was also found that beneficial microorganisms also die significantly.

In this regard, to restore the soil microbiological potential after solarization We studied the mustard cultivation influence with its subsequent plowing phytomass under the ploughland on the total soil biogenicity.

Earlier, we recommended that for the differentiated use of anti-wilt crop rotations, it is advisable to cultivate mustard with its subsequent plowing phytomass under the ploughland to 40 cm depth, after harvesting corn (jowari) for grain or silage (Marupov, 1988; 2017б).

## II. Materials and research methods

Experiments on this problem were carried out in 2015-2017 on meadow-alluvial soils, on a naturally highly contaminated field of “Kulkhatib” farm in Vobkent district of Bukhara region.

After harvesting wheat for grain, the experimental plot was prepared for sowing according to the generally accepted method on the farm (July 11). Then, according to the experiment variants, the plots were covered with 0,05 size film (July 17). After 48 days, i.e. on September 4, the film was removed from the experimental plots. According to the experiment variants, the mustard sowing was carried out (September 5) according to the recommendations of A. Marupov (1988).

Microbiological analyzes of the soil were carried out after harvesting wheat (July 11) before and after soil solarization (September 4) before sowing mustard in 2015 and in 2016 at the time before sowing and during the cotton ripening period, according to the generally accepted method of limiting dilutions according to S.F. Lazarev (1963).

The growing mustard was fed with nitrogen at 50 kg/ha rate. During the growing season, the plants were watered 3 times. When the plant height reached 1,0 m, their phytomass was crushed and plowed into the soil to 40 cm depth (November 10). When plowing the mustard phytomass, it was added 70% of phosphorus and 50% of potassium from the annual cotton fertilization rate (Marupov, 1988).

In 2016, the cotton variety Bukhara-10 was sown at the optimal time. The experiment was carried out in 4-fold repetition.

## III. Discussion of research results

Table 1 shows the microbiological soil analysis data after wheat harvesting and after soil solarization (2015). From the data in Table 1, it can be seen that after harvesting wheat (July 11), the total number of fungi is 9,0 thousand pieces, bacteria is 42,0 thousand pieces and actinomycetes is 100,0 thousand pieces in 1 g of abs. dry soil.

Table 1. Results of microbiological soil analysis.

“Kulkhatib”farm, Vobkent district, Bukhara region, 2015.

| П/П | Experience options | Fungis on Czapek | Bacteria on MPa | Actenomycitis on KAC |
|---|---|---|---|---|
| | **After wheat harvesting (July11)** | | | |
| | Пшеница | 9,0 | 42,0 | 100,0 |
| | **After soil solarization (September 4)** | | | |

| | | | | |
|---|---|---|---|---|
| 1 | Cotton plant over cotton plant | 10,0 | 76,0 | 92,5 |
| 2 | Wheat | 11,7 | 116,0 | 92,7 |
| 3 | Wheat, solarization | 2,0 | 50,5 | 71,5 |

In the same variant (September 4), an increase in the total number of microorganisms is noted, due to the enrichment of the arable soil layer with root and harvest wheat residues. The total number of fungi is 11,7 thousand pieces, bacteria is 116,0 thousand pieces and actinomycetes is 92,7 thousand pieces per 1 g of absolutely dry soil.

Under cotton, these indicators, respectively, by microorganisms types were 10,0; 76,0 and 92,5 thousand pieces in 1 g of absolutely dry soil.

In the variant where soil solarization was carried out, the total number of microorganisms sharply declined and their number was: fungi is 2,0 thousand pieces, bacteria is 50,5 thousand pieces and actinomycetes is 71,5 thousand pieces in 1 g of abs. dry soil.

Isolation of genus Fusarium fungi from the soil was not observed. Thermophilic fungi of the genus Aspergillus predominated.

As A.S. Letov (1934); P.N. Golovin (1953); A.I. Solovyova (1955); N.S. Mirpulatova (1973) and A. Marupov (1975; 1993) noted mainly wilted pathogens are found at 10-25 cm depth. At above 300 C temperatures, they die.

Our research showed that the soil temperature at 10-30 cm depth with solarization on average from 42.410C to 61.750C, which is fatal for the causative agent of wilt. This explains, against the solarization, the isolation absence of the wilted pathogen Fusariumsp from the soil into a pure culture.

Despite a significant decrease in bacteria number from 116,0 to 50,5 thousand pieces per 1 g of abs. dry soil, among them there are many colonies with antagonistic activity against the fungus Fusarium. There was also a decrease in the total number of actinomycetes.

Apparently, the high temperature and the soil humidity, created under the film, inhibit the total number of microorganisms, especially fungis.

This pattern shows the need to replenish the arable soil horizon with the necessary organic materials to restore the useful natural soil microbiological potential after solarization.

For this purpose, we sowed mustard on September 5, after removing the film used for soil solarization.

**The mustard phytomass harvest before plowing under the ploughland.** From the data in Table 2, it can be seen that the planting destiny of plants before plowing was 291,0 thousand/piece per hectare.(Fig.1).

Table 2. The state of the green manure culture before plowing under ploughland

“Kulhatib” farm, Vobkent district, Bukhara region, 10.11.2015

| № | Indicators | Mustard |
|---|---|---|
| 1 | Planting destiny of plants, thousand/ha | 291,0 thousand/ha |
| 2 | Average stem height , cm | 100,0 cm |
| 3 | Green mass weight , c/ha | 445,0 c/ha |
| 4 | Root weight, c/ha | 10,5 c/ha |
| 5 | Total plowed , c/ha | 455,5 c/ha |

The average stems height was 100,0 cm. Green mass weight of mustard is 445,0 c/ha and underground mass is 10,5 c/ha. In total, the mustard phytomass with roots was plowed under ploughland 455.0 c/ha.

Fig. 1. Mustard condition before plowing under the ploughland (November 10, 2015).

In 2016, against the background prepared in 2015, Bukhara-10 cotton variety was sown.

**Microbiological analysis of soil after solarization and green manure.**

The soil microbiological analyzes data for 2016 and 2017 on the study of the total number of fungi, bacteria and actinomycetes in the periods before sowing and during the cotton ripening period are presented in Table 2. From the data in Table 2, it can be seen that in 2016, with cotton monoculture, the total number of fungi before sowing cotton was 7,75 thousand pieces, and growing during the plants growing season to maturity, it reached 15,0 thousand pieces per 1 g of abs. dry soil.

The bacteria number in the period before sowing cotton seeds was 65,0 and actinomycetes 14,3 in 1 g of abs. dry soil.

The data obtained in 2017 in this variant show that there is no big difference in the total number of microorganisms development in comparison with 2016.

In the wheat+cotton variant, it is noted that in 2017 the total number of microorganisms development is somewhat more active in comparison with 2016. We believe that this is due to the decomposition timing of wheat plant residues.

In the wheat+solarization+cotton variant, the amount of mushrooms did not exceed 2,0 per 1 g of abs. dry soil. Apparently solarization had a detrimental effect on the fungi development.

In 2017, there was an increase in the total number of microorganisms that recovered during the cotton growing season. In the wheat+solarization+mustard variant for green manure+cotton, the rapid development of fungi was noted in the period before the cotton sowing and decreased by almost 50,0% during the cotton ripening period. In our opinion, this is due to the active participation of the soil microflora in the mustard phytomass decomposition plowed under the ploughland in the spring, and by the cotton maturation, due to the absence of easily mobilized organic material, the microorganisms' activity slightly decreased.

The bacteria and actinomycetes development also proceeded intensively in the variant where a large amount of organic material was plowed in, where bacteria amounted to 265,0 thousand pieces, and actinomycetes is 19.125 million pieces per 1 g of abs. dry soil. Antagonistic forms predominated among bacteria, which strongly suppressed the pathogen growth in pure culture.

Table 3. The total number of microorganisms in 1 g of absolute dry soil. «Kulkhatib» farm, Vobkent district, Bukhara region Bukhara-10 variety.

| № / № | Experience options | Years | Fungi on Czapek, thous. | | Bacteria on MPa, thous. | | Actinomycetes on KAC, mln. | |
|---|---|---|---|---|---|---|---|---|
| | | | before sowing | In maturation | before sowing | In maturation | before sowing | In maturation |
| 1. | Cotton plant over cotton plant | 2016 | 7,75 | 15,0 | 65,0 | 30,0 | 14,3 | 84,0 |
| | | 2017 | 8,0 | 3,75 | 94,0 | 16,25 | 15,0 | 150,2 |
| 2. | Wheat + cotton | 2016 | 6,75 | 14,0 | 57,5 | 70,0 | 14,9 | 11,1 |
| | | 2017 | 18,0 | 3,75 | 99,7 | 10,75 | 9,2 | 139,0 |
| 3. | Wheat, solarization + cotton | 2016 | 2,0 | 2,0 | 60,0 | 20,0 | 10,8 | 7,0 |
| | | 2017 | 14,25 | 10,25 | 188,5 | 8,25 | 9,75 | 191,5 |
| 4. | Wheat, solarization, green manure mustard + cotton | 2016 | 13,25 | 7,0 | 265,0 | 260,0 | 19,1 | 96,0 |
| | | 2017 | 10,75 | 16,25 | 204,0 | 8,75 | 5,25 | 130,0 |

Table 4 presents data for 2016 and 2017 on various dominant soil fungi species types isolation into a pure culture. The tabular data show that with cotton monoculture, the total number of fungi is 7,75 thousand pieces in 1 g of abs. dry soil. Among the isolated fungi, the dominant fungi were Aspergillus, Penicillium and Fusarium.

Isolation of fungi from the genus Trichoderma was not observed.

In the wheat+cotton variant with a total amount of mushrooms in 1g of abs. dry soil was 7.75 thousand pieces, Aspergillus was 3,0 thousand pieces, Penicillium 0,25 and Fusarium 0,75 thousand pieces in 1g of abs. dry soil.

In 2016, in the wheat, solarization, mustard for green manure + cotton variant, before cotton sowing, there is a rapid development of fungi, especially from the genus Aspergillus 8,25 thousand pcs per 1 g of abs. dry soil. Fungi from the genus Penicillium amounted to 1,75 thousand pieces 1 g of abs. dry soil. This variant had a disastrous effect on the fungi development from the genus Fusarium. It was noted that the fungi isolation from the genus Trichoderma in the amount of 0.25 thousand pieces in 1 g of abs. dry soil. Almost the same consistency is observed in 2017.

It should be especially noted that during the cotton ripening period, a decrease in the total number of fungi is observed, however, the number of fungi from the genus Trichoderma increases sharply and reaches 3,0 thousand pieces per 1 g of abs. dry soil. As is known, among the genus Trichoderma fungi, there are many strains that antagonize soil pathogens.

It is possible that they also perniciously influenced the pathogenic fungi development from the genus Fusarium simultaneously with solarization and green manure with the mustard phytomass.

We isolated from the soil three genus Trichoderma fungi, different in cultural and morphological characteristics, from the variant solarization, green manure+cotton, which are of great theoretical and practical interest in a biological method development for combating soil pathogens (Fig. 2).

Table 4. The amount of fungi in 1 g of abs. dry soil, thous.

«Kulkhatib» farm, Vobkent district, Bukhara region, Bukhara-10 variety

| № | Experience options | Years | Total Fungi | of them | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Asper gillus | Penicillium | Fusarium | Trichoderma | Mucor | Others |
| | | | Before sowing | | | | | | |
| 1. | Cotton plant over cotton plant | 2016 | 7,75 | 2,25 | 1,75 | 2,0 | 0,0 | 0,0 | 0,75 |
| | | 2017 | 8,0 | 6,5 | 1,25 | 0,0 | 0,0 | 0,0 | 0,25 |
| 2. | Wheat + cotton | 2016 | 6,75 | 3,0 | 0,25 | 0,75 | 0,0 | 0,25 | 0,5 |
| | | 2017 | 18,0 | 17,25 | 0,75 | 0,0 | 0,0 | 0,0 | 0,0 |
| 3. | Wheat, solarization + cotton | 2016 | 2,0 | 1,25 | 0,0 | 0,0 | 0,0 | 0,5 | 0,25 |
| | | 2017 | 14,25 | 13,5 | 0,75 | 0,0 | 0,0 | 0,0 | 0,0 |
| 4. | Wheat, solarization, green manure mustard + cotton | 2016 | 13,25 | 8,25 | 1,75 | 0,0 | 0,25 | 0,25 | 2,75 |
| | | 2017 | 10,75 | 7,0 | 3,5 | 0,25 | 0,0 | 0,0 | 0,0 |
| in maturation | | | | | | | | | |
| 1. | Cotton plant over cotton plant | 2016 | 15,0 | 6,0 | 3,0 | 5,0* | 0,0 | 0,0 | 1,0 |
| | | 2017 | 3,75 | 3,75 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2. | Wheat + cotton | 2016 | 14,0 | 5,0 | 3,0 | 4,0* | 0,0 | 1,0 | 1,0 |
| | | 2017 | 3,75 | 3,75 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 3. | Wheat, solarization + cotton | 2016 | 2,0 | 0,0 | 1,0 | 0,0 | 1,0 | 0,0 | 0,0 |
| | | 2017 | 10,25 | 0,5 | 0,0 | 0,0 | 9,75 | 0,0 | 0,0 |
| 4. | Wheat, solarization, green manure mustard + cotton | 2016 | 7,0 | 2,0 | 2,0 | 0,0 | 3,0 | 0,0 | 0,0 |
| | | 2017 | 16,25 | 15,25 | 0,25 | 0,0 | 0,75 | 0,0 | 0,0 |

* Note: abundant secretion of the fungus *Fusarium.*

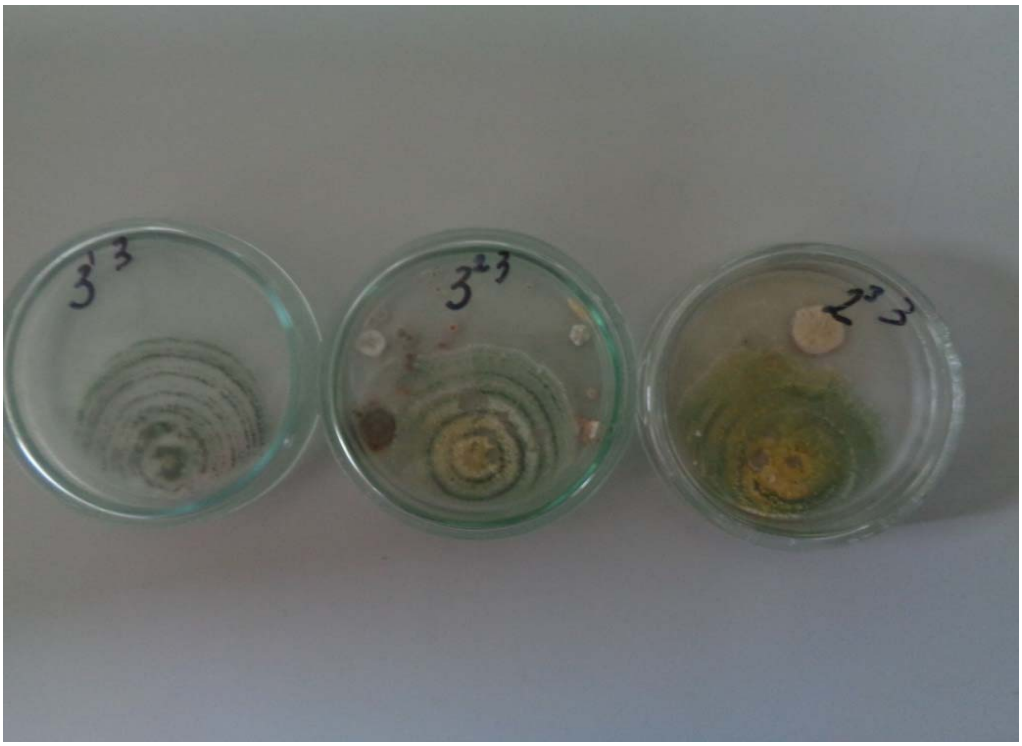

Fig. 2. Fungi strains from the genus Trichoderma isolated from the variant solarization+soil green manure

## IV. Conclusion

Thus, the arable horizon solarization of a cotton field, followed by green manure under the ploughland, inhibits the infection development of the causative agent of wilt, the fungus Fusarium, in the soil.

The soil enrichment with easily mobilized mustard phytomass increases the fungistatic soil activity, due to an increase in the number of mycolytic bacteria and natural antagonist fungi forms, especially from the genus Trichoderma. As a result, there is a sharp decrease in the cotton wilt incidence, the microbiological potential restoration of the soil, a decrease in harmful toxic pathogens substances that negatively affect young plants and contributes to the number of plants preservation per hectare.

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