

The Influence of Presowing Laser and Gamma Irradiation on the Cucumber Resistance Towards Angular Spots (*Pseudomonas lachrymans*)

D. Cholakov, Irina Kutova

Higher Institute of Agriculture - Plovdiv, Bulgaria

Abstract: The bactericide effect of two beams towards the angular spots agent (*Pseudomonas lachrymans*) by the plants developed from infected seeds and by the artificially infected plants developed from uncontaminated seeds was studied. It was determined that as a result of irradiation the field germination of contaminated seeds has been increased as well as the activity of some respiratory enzymes in the leaves. At two variants of infection the degree of the attack became smaller. The bactericide effect was better revealed at the combination laser+ gamma rays.

Key words: angular spots, cucumber, enzyme activity, laser and gamma irradiation

Introduction

The use of beam laser and gamma treatment of seeds as a means of reducing the damages and the negative results caused by fungal and bacterial diseases is based on the positive influence upon the vegetative and reproductive behaviour, the increase of the total vitality of plants and their resistance to the unfavourable conditions (Garibyan, 1986; Kuchin, 1986). The approval of this method as an important element in the elaboration of ecological apprehensive technologies for stimulation of vegetable crops, requires realization of concrete investigations to clarify the possibility for radiobiological effect multiplication as regards the decrease of produced production contamination and an improvement of its ecological state through an influence on the degree of damage of plants caused by economically important diseases and a reduction of the use of fungicides.

Material and methods

The experimental work was carried out under laboratory conditions. Seeds from cucumber cv. Gergana were irradiated with helium-neon laser by 632.8 nm wave length and exit power 20 mw, and with gamma rays from radioactive cobalt (Co^{60}). Untreated seeds were used as control seeds. The following variants of irradiation were tested: 1) seven-fold laser irradiation (Cholakov and Kartalov, 1990); 2) irradiation with gamma rays - 10Gy dose (Sergina and Orlov, 1984); 3) irradiation with laser + gamma rays.

The development of disease on plants obtained from seeds infected with bacterial suspension of *Pseudomonas lachrymans* in concentration 10^8 cfu/ml as well as on the artificially infected plants with bacterial suspension in concentration: 10^0 , 10^2 10^4 and 10^8 cfu/ml was studied. At the stage of 1-2 leaves and over again at the stage of 5-6 leaves test plants from cucumber cv. Pobeda F_1 as an indicator were infected. For that purpose a suspension was prepared from filtrate taken from infected plants of cv. Gergana. The activity of peroxidase and polyphenoloxidase enzymes was studied in infected and uninfected plants (Pochinok, 1976).

Result and discussion

The carried out investigations and the observations on the vitality of infected seeds traces out comparatively well expressed bactericide effect. When the field germination of the contaminated and uncontaminated seeds was compared, it could be seen (table 1) that only in the unirradiated control seeds the value of this index changes considerably as a result of contamination and decreases by 22%. In the contaminated as well as in the uncontaminated seeds the germination of the irradiated variants is considerably higher in comparison with the control seeds. These findings give a reason to note that the irradiation directly or indirectly influences on the agent of disease and decreases its negative influence the germination of seeds. The data from the same table show that as a result of irradiation the degree of the attack on the cucumber plants developed from infected seeds decreases considerably. The percentage of overrun plants is least by seed laser irradiation.

Tab. 1. Field germination of seeds and degree of attack from *Pseudomonas lachrymans* average for the period 1996-1997

Indices	Variants of irradiation			
	Non irradiation (c)	Laser irradiation	Gamma irradiation	Laser+gamma irradiation
Germinated plants from 100 uncontaminated seeds	88	94	93	95
Germinated plants from 100 contaminated seeds	66	84	83	87
Healthy plants	0	57	48	65
Diseased plants	66	17	35	22
Degree of attack, %	100.0	20.2	42.2	25.3

The bactericide effect of irradiation was confirmed from the results of the degree of damage of plants infected with a bacterial suspension of *Pseudomonas lachrymans* (table 2). Based on the data, concentrations of suspension the spots builded per one leaf are most for the control seeds and with an enhancement of concentration from 10^0 cfu/ml to 10^8 cfu/ml their number increases more than three times. The symptoms of the disease appeare more slowly and more weakly when the plants are obtained from irradiated seeds. By them the enhancement of the bacterial suspension concentration does not induce a very high increment of the infection and the number of the spots grows up 1.5-2.3 times. On the other side it is seen that an average number of the spots per one leaf in the irradiated variants is from 2.8 to 7.4 times smaller in comparison with the control variant. The variant irradiated consecutively with laser +gamma rays is least contaminated. The obtained results show that in spite of the absence of direct irradiation effect on the agent of disease, the plants developed from irradiated seeds are damaged more slightly. The explanation can be found in their increased vitality and is connected with this higher adaptation ability and resistance to shock factors (Golovko and Andrushin, 1979; Vasilevski et al., 1994).

Tab. 2. Influence of irradiation on the degree of development of the angular spots agent (*Pseudomonas lachrymans*)

Variants of irradiation	Number of spots per one leaf by concentration of bacterial suspension											
	10^0 cfu/ml			10^2 cfu/ml			10^4 cfu/ml			10^8 cfu/ml		
	1996	1997	$\bar{X}$	1996	1997	$\bar{X}$	1996	1997	$\bar{X}$	1996	1997	$\bar{X}$
Non irradiation /c/	9	5	7	13	9	11	21	15	18	24	16	20
Laser irradiation	5	3	4	4	4	4	5	5	5	7	5	6
Gamma irradiation	3	3	3	5	3	4	5	7	6	6	8	7
Laser + gamma irradiation	2	4	3	3	5	4	4	6	5	6	4	5

In support of the noted tendency are results for the sap infection of plants developed from infected seeds tested on tests - indicator for *Pseudomonas lachrymans* (table 3). Regardless of the stage of infection, the percentage of the diseased plants from cv. Pobeda F_1 applied as an indicator is considerably less, when a sap of contaminated plants developed from irradiated seeds is used for that purpose. On the basis of this, filtrate of these plants is less bacteriological in comparison with the plants developed from infected unirradiated seeds. The attack is most weakly revealed in the combination laser + gamma rays, where the percentage of the tested diseased plants is 3.4-3.7 times smaller in comparison to the control plants.

Lower sensibility of the plants developed from irradiated seeds is probably connected with the registered increasment of their enzyme activity which influences the metabolism and development of pathogens. Many authors

prove a correlation between the plant hardiness towards diseases and the raised activity of some enzymes related to respiration (Farkas and Kiraly, 1962; Tomijama and Stahm, 1966;). In this sense, the results about the activity of some respiratory enzymes in the leaves of the experimental plants are indicative (table 4). It is seen that in the uninfected plants, as a result of irradiation, the peroxidase activity increases by 18.6-20.3% and the polyphenoloxidase activity - by 14.6-17.9%. The higher activity of two enzymes taken alone is a factor for a stronger reaction to the unfavourable conditions and shock factors. This decreases the negative effect and degree of damage. On the other side, under the influence of the changes in the metabolism of plants developed from irradiated seeds, it is not impossible to change the metabolism of a pathogen and thus lose partially its pathogenicity. According to some authors (Kurganova, 1977), the determined oxidation of the phenol compounds to lignine can lead to lignification not only of the tissues at the place of infection, but also of the germinated tube of the pathogen.. The participation of peroxidase in this process is connected with a formation of necrotic barrier, which decreases the permeability of the cellular membranes for the pathogene and in this way hinders its penetration into the plant tissues (Macko et al., 1968).

Tab. 3. Infection of sap of plants developed from contaminated seeds tested on an indicator of *Pseudomonas lachrymans* (cv. Pobeda F₁)

Variants of irradiation	Infected plants, number	Diseased plants by					
		infection in stage 1-2			infection in stage 5-6		
		leaves			leaves		
		1996 number	1997 number	$\bar{x}$	1996 number	1997 number	$\bar{x}$
Non irradiation /c/	30	24	26	86	24	29	88
Laser irradiation	30	7	13	33	10	8	30
Gamma irradiation	30	11	8	32	8	13	35
Laser + gamma irradiation	30	7	10	28	9	6	25

Tab. 4. Influence of irradiation on the peroxidase and polyphenoloxidase enzyme activity in cucumber leaves, cv. Gergana (in % to the control)

Variants of irradiation	Peroxidase activity		Polyphenoloxidase activity	
	uninfected plants	infected plants	uninfected plants	infected plants
Non irradiation /c/	100.0	100.0	100.0	100.0
Laser irradiation	119.4	141.5	117.9	127.9
Gamma irradiation	120.3	143.7	116.9	125.9
Laser + gamma irradiation	118.6	137.4	114.6	122.4

A more active enzyme action of the plants developed from irradiated seeds after their infection was determined too, when the first symptoms of the

disease appeared. The enhancement of the activity of both enzymes compared to the control seeds is considerably higher than that fixed for the infected plants (table 4). Depending on the variant of irradiation the values of this increase are by 37.4-43.7% higher for peroxidase and by 22.4-27.9% for polyphenoloxidase. Obviously, the bacterial intervention provokes the protected reaction of plants, which results in the increasement of the enzyme activity.

Conclusion

The combined or independent presowing laser and gamma irradiation of cucumber seeds decreases the plant sensibility to the disease angular spots.

The bactericid effect is more strongly revealed in the combination laser+gamma irradiation.

The beam treatment with the indicated physical agents enhances the field germination of infected seeds by 21-23%, decreases the degree of attack of the developed plants by 57.8-79.7% and considerably reduces the development of disease and the damages on the leaves of the plants infected after germination.

The connection was made between the smaller sensibility to the angular spots of the plants developed from irradiated seeds and the increased activity of the enzymes of respiratory metabolism - peroxidase and polyphenoloxidase.

References

- Cholakov, D., P. Kartalov (1990): *Rastenievadni nauki*, vol XXVIII, No 10, p. 62-66
- Farkas, G., Kiraly, Z. (1962): Role of phenolic compounds in the physiology of plant disease and disease resistance. *Phytopathology*, 52, 2: 105-155
- Garibyan, G. (1986): *Biologicheskii bulletin na Armenia*, vol 39, No 12, p. 1018
- Golovko, T., Andruschin, M. (1979): *Problemi bioenergetiki organizma i stimuljacija lasernim izlucheniem*, Alma-Ata, Edition, Kainar, 123
- Kuchin, V. et al. (1985): *Sbornik nauchni dokladi*, Kishinev, p. 67-69
- Kurganova, L. (1977): *Radiobiologia*, v.(17), No 1 : 44-46
- Mascho, V. et al. (1968): *Phytopathology*, No 58, p. 1254
- Pochinok, H. (1976): *Metodi biohimicheskovo analiza*, Kiev, "Naukova Dumka", p. 213-216
- Sergina, M., Orlov, V. (1984): *Obluchenija semjan gamma islucheniem*, *Kartofel i ovoschi*, No 12 p. 24-27
- Tomijama, K., Stahman, H. (1969): Alternation of oxidative enzyme in potato tuber tissue by infection with *Phytophthora infestans*, *Phytopathology*, 59, 1966
- Vaselevski, G. (1994): *Agroecological investigation for laser application*. Final report, International project, Scopje, R. Macedonia.

**UTICAJ PRESETVENOG LASERSKOG I GAMA ZRAČENJA NA
OTPORNOST KRASTAVCA PREMA PEGAVOSTI
(*Pseudomonas lachrymans*)**

-originalni naučni rad-

D. Čolakov, Irina Kutova
Viši poljoprivredni institut - Plovdiv

Rezime

U radu je izučavan baktericidni uticaj dva snopa zračenja na uzročnik pegavosti (*Pseudomonas lachrymans*) kod biljaka dobijenih iz zaračenog semena i veštački zaračenih biljaka dobijenih iz nezaračenog semena. Utvrđeno je da je, kao rezultat ozračenja, povećano klijanje zaračenog semena kao i aktivnost nekih respiratornih enzima u lišću. Kod dve varijante zaraze, stepen napada je bio slabiji. Baktericidni uticaj se bolje ispoljio u kombinaciji laserskog i gama zračenja.