Original Research Article

Resistance degree of two hot pepper hybrids to pests in organic farming

ABSTRACT

The genetic basis of the hybrid and growing conditions can significantly affect the resistance to certain types of pests in environmental protection. Some hybrids have a thicker fruit skin, higher concentrations of capsaicin (the active ingredient in hot peppers) or that the fruit contains secondary metabolites that repel pests. This is very important in environmental protection, where synthetic preparations are not used. The degree of resistance of hybrids can also differ according to which types of pests are dominant in the environment. The use of natural enemies of pests (parasitoids, predators) or plant extracts can significantly increase the resistance of hybrids that possess the genetic basis for resistance. Cultivation of hybrids in real conditions is the most reliable way to obtain data on the resolution of the resistance of two hybrids.Organically grown peppers taste better, are healthier and more attractive to consumers. Ecological protection contributes to preserving soil fertility and reducing environmental pollution, which ensures long-term stable yields and reduces dependence on expensive chemical agents.

Key words: Genetic basis, ecological agriculture, hybrid resistance, dominant pests.

INTRODUCTION

The origin of pepper is related to America, where it is grown as an autochthonous perennial plant in the southern parts of North and Central America. The homeland of this species is South America [1]. In most cases, including Bosnia and Herzegovina, pepper is grown as an annual crop. It means that pepper is grown from seed every year, due to the climatic conditions prevailing in Bosnia and Herzegovina. Pepper (*Capsicum annuum L*.) is a vegetable crop, known for the high nutritional value of its fruit, rich in many phenolic substances, vitamins and antioxidants [2,3]. Because of the nutritional value of its fruits, which are an excellent source of a wide range of phytochemicals with well-known antioxidant properties. Major antioxidants include carotenoids, capsaicinoids and phenolic compounds, especially flavonoids, quercetin and luteolin [4,5]. Due to domestication, mass production and intensive cultivation, peppers are exposed to attacks by various pests. Commercially grown hot and sweet peppers have lost thrips resistance and become susceptible to several species of thrips, particularly *Frankliniella occidentalis* (western flower thrips) and *Thrips tabaci* (onion thrips) [6,7].

Differences in the degree of resistance of hot pepper hybrids to pests can be significant and depend on the genetic characteristics of each hybrid.

Frequent and intensive use of chemical pesticides leads to the emergence of resistance among existing species of pests and sometimes to the development of new species [8].

The insecticides used are not always effective enough, therefore integrated pest management (IPM) practices have been implemented and combined with chemical and biological strategies to grow healthy crops [9,10].

The use of host plant resistance is one of the most effective management approaches to minimize damage from phytophagous pests [11]. In environmental protection, resistance to pests can be manifested through several aspects:

Some hybrids have been developed to contain natural genes that make them less attractive to pests or make them more difficult to feed on. Hybrids with thicker fruit walls or stronger stems may be more resistant to damage caused by pests. Different hybrids can produce different natural pesticides, such as alkaloids [12], which can repel or kill pests. Some hybrids are better able to tolerate stressful conditions, such as drought or high temperatures, which can reduce the risk of infestation [13].

In ecological protection, it is important to use hybrid varieties that are resistant to local pests, which can reduce the need for chemical pesticides and enable sustainable production. Taking into account the local environmental conditions and the type of pest is crucial for choosing the right hybrid. In conventional agriculture, the rigorous use of chemical inputs such as herbicides, fungicides, nematicides and pesticides in recent years has led to negative effects on soil microflora and reduced soil fertility [14].

In this research, the influence of planting material and seed category on the resistance, quality and yield of hot pepper Fortessa F1 (hybrid) and Hungarian SS (standard seed) in organic production was examined.

MATERIALS AND METHODS

Container planting material was used as planting material for Fortessa pepper, seedlings were used for Hungarian pepper. For the purpose of research, 100 Fortesse seedlings and 100 Hungarian seedlings were planted under foil with a drip irrigation system. The experiment was set up at the „Konjević polje" location, at 192 m above sea level, in a greenhouse. The plants were transplanted on May 21, 2024. year, and nutrition and protection were applied at the same time, with the same means and in the same way (table 1, table 2). The inputs used are allowed in organic production by the certification body. The follow-up lasted 4 months or 120 days and included the analysis of several parameters: period of root scarring, resistance to diseases, resistance to insects, yield and quality of fruits. During the research, the temperature of the air and soil and the period of leaf humidity were monitored by means of a meteorological station installed at that location (iMethos 3.3).

Picture 1. "Agrofood" Konjević Polje, Bratunac, 44^{0}14´15´´N 19^{0}06´28´´E

Organic fertilizers were used for fertigation, and preparations allowed in organic production were used to protect plant health.

Table 1. – Records of fertilizer application

No.	Date of fertilization	Name of fertilizer		Application of fertilizer
1.	20.05.2024	Pelletized horse + cow +	Organic matter + organic NPK	Inkorporation

		chicken manure		
2.	31.05.2024	Team F	Organic N-K fertilizer with organic acids	Fertigation
3.	13.06.2024	Aminoton + Slavol	Organic N fertilizer with amino acids + mikrobiological fertilizer	Fertigation
4.	19.06.2024	Trazex	Microelements	Fertigation
5.	29.06.2024	Calcium	Ca fertilizer	Fertigation
6.	01.07.2024	Bacterial	Microbiological fertilizer	Fertigation
7.	19.07.2024	Calcium	Ca fertilizer	Fertigation
8.	31.07.2024	MYR K	K fertilizer	Fertigation
9.	10.08.2024	MYR K	K fertilizer	Fertigation
10.	20.08.2024	Barrier	Ca + Si fertilizer	Fertigation
11.	30.08.2024	Aminoton	Organic N fertilizer with amino acids	Fertigation
12.	15.09.2024	Team F	Organic N-K fertilizer with organic acids	Fertigation
13.	20.09.2024	MYR Ca+B	Ca + B fertilizer	Fertigation
14.	10.10.2024	MYR K	K fertilizer	Foliar

Table 2. – Records of application of bio-insecticide

No.	Date of fertilization	Name of bio-insecticide	Reason for application bio-insecticide	Application of bio-insecticide
2.	13.06.2024	Oliveg	Preventive protection against aphids	Foliar
4.	26.06.2024	Neem Azal	Preventive protection against aphids and mites	Foliar
5.	10.07.2024	Oliveg	Preventive protection against aphids	Foliar
6.	15.07.2024	Sumpor	Preventive protection against mites	Foliar
7.	20.07.2024	Neem Azal	Preventive protection against aphids and mites	Foliar
8.	30.07.2024	Sulfur	Preventive protection against mites	Foliar
9.	05.08.2024	Neem azal	Preventive protection against aphids and mites	Foliar
10.	15.08.2024	Sulfur	Preventive protection against mites	Foliar
11.	25.08.2024	Oliveg	Preventive protection against aphids and mites	Foliar
12.	04.09.2024	Neem Azal	Preventive protection against aphids and mites	Foliar
13.	10.09.2024	Sulfur	Preventive protection against aphids and mites	Foliar
14.	20.09.2024	Sulfur	Preventive protection against mites	Foliar

Chart 1. – Air temperature per day

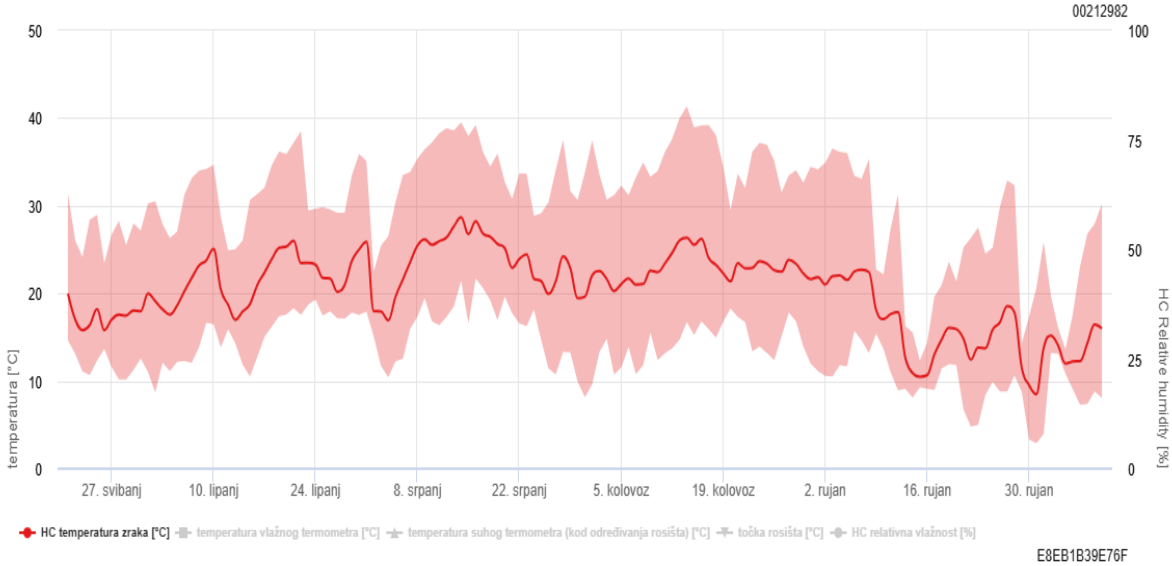
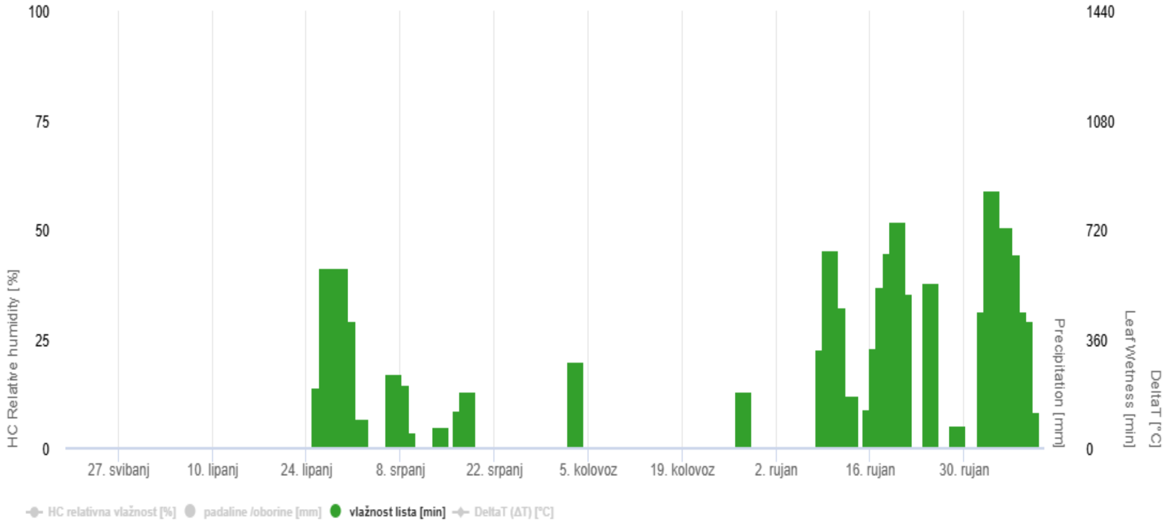


Chart 2. – Soil temperature per day

According to the data from charts 1 and 2, we can conclude that it was a very hot summer, that the air temperatures were between 35-41˚ C, and in the greenhouse the temperatures were even higher. The soil temperature in the greenhouse was an average of 23˚C. It is to be expected in such warm days that there is an increased attack of mites and thrips.

Chart 3. – Leaf humidity per minutes and percentage



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1. RESULTS AND DISCUSSION

Table 3. – Experiment labels

Crop	Label in text	Seed category	Category of planting material	Number of plants
Hot pepper Fortessa	P-F	F1 hybrid	Container seedlings	100
Hot pepper Hungarian	P-H	Standard seed – SS	Seedlings	100

In the experiment, the resistance of hot pepper to the appearance of pests was examined, where the Fortessa hybrid and the Hungarian variety were taken. Both experiments had protection and nutrition in accordance with the Law on Organic Production, which is stated in tables 1 and 2.

Table 4. – The appearance of the pepper pest monitored through experiment

No.	Name of microorganisms / pest	Label in text
1.	*Frankliniella occidentalis*	FO
2.	*Ostrinia nubilalis*	ON
3.	*Aphididae*	A
4.	*Panonychus ulmi*	PU
5.	*Trialeurodes vaporarium*	TV

Table 5. – Rooting of plants after planting

Label	Number of planted plants	10 days after planting	20 days after planting
		% rooted plants	% rooted plants
P-F	100	70%	98%
P-H	100	35%	90%

In addition to the resistance between the two pepper varieties, the influence of the planting material on scarring and the condition of the plants in the subsequent growing season was also monitored. Table 5 shows the degree and speed of rooting between the container seedling of the hybrid Fortessa and the seedling of Hungarian. After 10 days, when the first monitoring was carried out, 70% of the Fortessa seedlings took root in the soil and continued with vegetation, and in the second monitoring after 20 days, 98% of the seedlings or 98 plants took root, while two died. On the other hand, the percentage of Hungarian seedlings that survived is 35%, 10 days after planting, or 90%, 20 days after planting. It is clearly seen that the percentage of seedling survival is better and faster with container seedlings and that this certainly further affects the condition of the plant and its immunity.

Table 6. – Results of monitoring pest attacks in the days after planting

Label	Disease-label	15 days	30 days	45 days	60 days	75 days	90 days	105 days	120 days
		% pest attack							
P-F	FO	0	0	0	0	0	0	0	0
P-H		0	0	0	0	0	0	0	0
P-F	ON	0	0	0	0	0	0	0	0
P-H		0	0	0	0	0	0	0	0
P-F	A	11	17	17	0	0	0	0	0
P-H		18	25	25	0	0	0	0	0
P-F		0	0	7	15	22	31	37	41
P-H		0	0	12	28	35	48	64	72
P-F	TV	0	0	0	0	0	5	8	20
P-H		0	0	0	0	11	23	28	34

Table 7. – Number of plants that died due pest attacks

Label	Disease - label	15 days	30 days	45 days	60 days	75 days	90 days	105 days	120 days
		Number of died plants							
P-F	A	0	0	0	0	0	0	0	0
P-H		0	0	0	0	0	0	0	0
P-F		0	0	0	0	0	0	0	0
P-H		0	0	0	0	5	21	30	37
P-F	TV	0	0	0	0	0	0	0	0
P-H		0	0	0	0	0	0	0	0

Table 6 shows the results of monitoring pest attacks in the days after planting with the percentage of attacks. The attack percentage actually refers to the number of attacked plants in relation to the total planted number. The experiment did not have any attacks by the corn moth and the California thrips. At the beginning of the growing season, aphids appeared on a few plants, but over time their number stagnated and completely stopped, partly due to high temperatures and partly due to the protection that was implemented. The white shield fly started to cause damage at the end of production, more so on the Hungarian pepper trial, but these damages were not economically significant. Finally, the biggest attack was by the red fruit spider, which started its attack in the middle part of the vegetation and eventually caused great economic damage. As many as 72% of plants of the Hungarian variety were attacked by mites, in contrast to Fortesse where the attack was 41%. Also, the intensity of the attack was different, as can be seen in Table 7, where in the P-SS trial, as many as 37 plants died due to the mite attack. In contrast to the P-SS trial, the pepper trial with the Fortessa hybrid was far more resistant. The attack was also present there, but the plants, with the help of the bio-protection listed in Table 2, did not die, but their yield was only reduced.

Table 8. – Plant yield in kg

Label	I class yield	II class yield	Total yield	Yield per plant
P-F	103	29	132	1,32
P-H	45	25	70	0,70

Finally, table 8 shows the total yield and yield per plant in kilograms. Fortessa pepper had a yield of 1.32 kg per plant, while Hungarian pepper had 0.70 kg per plant, which is 47% less. In addition to the fact that the Hungarian pepper did not have the reproductive potential of the Fortessa pepper and a good initial start of planting material, it suffered a large attack of mites. The mite reduced the yield in two ways: 1. by the death of the plants so that in the end those plants could not produce any results, 2. the diseased plants focused all their energy on defending against the attack of the mite, as a result of which they rejected the fruits. In organic farming, in addition to bio protection and frequent treatment with preventive means, we must choose more resistant varieties and hybrids that will be able to resist diseases and pests. Also, we must have good and healthy planting material that will allow the plants to quickly adapt to the new environment so that they can focus their energy on development and fruiting.

CONCLUSION

Ecological protection in pepper cultivation can be profitable. It requires higher initial investments and more attention and more precise production management. Organic production provides long-term economic, health and environmental benefits. The selection of resistant hybrids for cultivation is the primary task in ecological pepper cultivation.

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