BIORATIONAL PESTICIDES IN AN INTEGRATED PROTECTION SYSTEM OF APPLE TREE

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Abstract

The article discusses the most important results of use the biorational preparations (elicitors) Reglalg, Recol and Paurin as inductors of plant immunity to apple scab (pathogen – *Venturia inaequalis* Aderh. ascigerous and *Fusicladium dendriticum* (Wallr.) Fuch conidial stages) in an integrated protection system. The experiments were carried out in 2015 in Bacioi mun. "AgroBrio" Ltd., on apple varieties Vagner Prizovoi on the area of 2 hectares. The scab prevalence (P) ranged from 14.1 to 18.7 (on leaves) and 9.8 to 18.7 (on fruits). In the chemical standard scab prevalence consisted 23.4 both on leaves and fruits. The development of disease (R) varied from 2.0 to 3.5 (on leaves) and from 4.2 to 5.5 (on fruits) and was comparable to the chemical standard (2.2 and 4.3 on leaves and fruits respectively). In reference the scab prevalence (P) reached to 37.0 on leaves and 43.7% on fruits, the degree of development of disease R was 19.1 on leaves and 29.2% on fruit. Chlorophyll index depended on variants: Reglalg 103; Recol 98.99 and Paurin 93.06 mg / cm^2 (standard – 80.22 and reference – 68.9 mg/cm^2). The growth of shoots on the variants ranged from 19.7 to 23.2 cm (the standard – 20.7 and control – 15.7 cm).

Key words: Bioelicitors, Inductors of Immunity, Apple Tree, Biometric indices

The apple tree occupies one of the most leading places among fruit cultures, cultivated in the Republic of Moldova. One of the most important reason of a low productivity and insufficient quality of fruits is a wide spread of diseases. Apple scab and pear scab are the main diseases of these cultures practically in all zones of their cultivation, the agents of which are similar on biology and pathogenesis (Zeynalov A.S., 2013; Kashirskaya N.Ya. et al., 2013; Kolesova D.A., Chmyri P.G., 2006). The harm from scab consists not only in quantity reduction and product quality degradation, but also in increase of losses at storage (Zueva I.M., 2000; Boldyrev M.I., Kashirskaya N.Ya., 2004; Biggs A.R., 1990). Very affected trees are decreased in growth, the buds are wintered unprepared, their winter resistance decreases, as well as may be observed an early leaf fall (Vahsheh I.N.N., 2014). At mass ictus the losses of marketable fruits may reach 60-80% (Kolesova D.A., 2006; Drozda V.F. et al., 2013).

Protection of apple against scab should be carried out fully considering the agro-climatic characteristics of growth zones, cultivated varieties etc. (Sanz-Sáez Á. et al., 2012; Zueva I.M., 2005). Regarding the chemical protection, the specialists' attention is directed on decrease of fungicide treatments and their consumption rates, substitution of fungicides with high consumption rates to more effective with lower consumption rates (Artyuhov A.V. et al., 2000; Alekseeva S.A., Bystraya G.V., 2003; Ismailov V.Ja., Kovalenkov V.G., 2002; Jacuba G.V., 2005; Voineac V., et al., 2009). The alternative to chemical pesticides may be elicitors –preparations of biogenic origin which contribute to immunity improvement and renewal of self-regulation mechanisms at plants (Mueller S.C., Teuber L.R., 2007; Voineac V., 2011). The application of elicitors is prospectively as a result of their high ecological compatibility: being safe for environment, thus the elicitors decrease the pressing of chemical protective means of plants on agrocoenoses.

Nowadays there are elaborated and are in the development stage many substances of biogenic origin, applied in practice of agricultural crops protection against diseases, as well as growth regulators and inductors of immunity (Daskaliuc A.P. et al., 2012; Boldyrev M.I et al., 2007; Bashirov R.M., 2003; Kirichenko E.V., Sergienko V.G., 2011; Pozharsky V.G., 2014; Voinyak V.I., Daskaliuc A.P., Todiraş V.A., 2013; Salahutdinov N.F., 2013). These are the preparations on the basis of fungi, bacteria, plant extracts and others.

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In our Institute of Genetics, Physiology and Plant Protection of ASM for many years have been received such preparations as Reglalg, Recol and Paurin (Bykhovets A.I., Goncharuk V.M., Petrusevich I.I., Voynyak V.I., Todiraş V.A., Daskalyuk A.P., 2011; Todiraş V., Tretiacova T., 2013; Kirichenko E.V., Sergienko V.G., 2011), which are successfully applied in practice of plant protection as fungicides or stimulators and inductors of immunity on such crops as potato, tomatoes, grape and others.

The aim of this work consisted in study of effectiveness of biological preparations – stimulators of resistance and plants growth (Reglalg, Recol and Paurin) against apple scab – *Venturia inaequalis* at their application in an integrated protection system of apple tree.

MATERIAL AND METHOD

Scientific *researches* shall be carried out on the territory of the Republic of Moldova, in apple garden "AgroBrio" Ltd., Bacioi mun., at area of 2 ha, Vagner Prizovoi variety.

As immunomodulators and growth stimulators (bioelicitors) shall be used three preparations Reglalg 0.5 l/ha, Recol 2 l/ha and Paurin 10 g/l. Consumption of working solutions – 300 l/ha (1.5 l/tree) (Indrumări metodice ..., 2002).

Reglalg preparation is presented by Professor Alexandru Dascaliuc (IGPPP ASM). Reglalg is a natural plant growth regulator (PGR) extracted from algae in special conditions. It improves the vitality and quality of the crops by natural means. In mixture with fungicides and pesticides, Reglalg diminishes their effective doses. As a result, the detrimental effect of chemical crop defenders on the environment and human health could be reduced, while the efficient use of natural resources improved.

Recol preparation is presented by PhD. of biology Todirash V.A. and created on the basis of plant extract *Reynoutria sachalinensis* (15 g/l ±3%), with a wide spectrum of action against mildew at grape, apple, cucumbers, melon. Certificate of conformity in the Republic of Moldova: 02-0866 as of June 22, 2011. Physical-chemical properties: Solution; easily soluble in water; high adhesion and long-duration keeping on surface of the plants which are treated. Action mechanism: Resistance inductor.

Paurin is a bacterial preparation on the basis of terricolous saprophitic bacterium *Pseudomonas fluorescens* CR 330D, developed by a group of scientists IPPEA ASM under the direction of PhD. of biology Lemanova N. B.

The experience shall be made three times by 3 model trees in each variant. The treatment was made three times (by shoulder sprayers of KWAZAR type) – the first till blossoming - April 24, 2015, the second at the end of blossoming - May 04, 2015, the third in the stage of fruits growth (fruits size 10 mm) - May 13, 2015.

Samples of branches, fruits, leaves shall be collected at different distances from margins according to a unified method: 15 pcs (branches) 3 times in each variant; 100 pcs (fruits, leaves) 9 times in each variant (Indrumări metodice ..., 2002).

The obtained results were compared with the chemical standard and not-treated control. The following indices were determined:

1. The apple scab prevalence (P) on leaves and fruits;
2. The level of affect by scab the leaves and fruits;
3. Chlorophyll index;
4. Growth of shoots.

The records on affect by scab were carried out for leaves and fruits. To calculate the intensity of disease progression, each recorded organ (leave, fruit) was estimated visually according to following generally accepted scale:

Table 1

Rating scale of affect of generative organs of plants by diseases

Point	Disease affection
0	affection absent
0.1	single affection by agent
1	affected till 10% of leave (fruit)
2	affected 11-25% of leave (fruit)
3	affected 26-50% of leave (fruit)
4	affected more than 50% of leave (fruit)

Determination of disease development (R) on leaves and fruits.

The mean value of disease development was calculated according to formula:

$$R = \frac{(r \times b) \times 100}{n \times e} \qquad (1)$$

where: R – degree or intensity of disease development;
r × b – sum of products of plants number on point corresponding them;
n – total number of recorded plants;
e – higher point of applied scale.

Determination of scab prevalence (P) on leaves and fruits.

Determination of scab prevalence on leaves and fruits was carried out according to formula

$$P = \frac{n \times 100}{N} \qquad (2)$$

where: P – disease development;
n – number of ill plants in sample (leaves, fruits);
N- total number of recorded plants (leaves, fruits).

Chlorophyll index was determined with the help of a small portable measuring instrument of chlorophyll concentration Portable Chlorophyll Fluorometer PAM-2100. The action of device is based on a spectrum method of fast and non-destructive determination of chlorophyll content in noninjured leave.

The length of sprouts was measured with the help of a ruler, selection criteria for each variant made up 30 measurements of sprouts.

The statistical data processing was carried out by generally accepted methods (Dospehov B.A., 1979).

RESULTS AND DISCUSSIONS

In the central zone of the Republic of Moldova in 2015, the period of mass blossoming of apple tree Vagner Prizovoi variety in garden was in the third decade of April. The maximum daily temperature of April reached 18.4C°, minimum nocturnal - 6.0C°. In the third decade of April the daily temperature was till 22-23C°. The quantity of precipitations in April made up 47 mm. Therefore in this period was carried out the first treatment of plants of apple tree by biopreparations for the purpose of immunity induction against diseases. Upon termination of mass blossoming, during the period of leaves fall was carried out the second treatment, because the meteorological conditions were favorable for scab prevalence – maximum daily air temperature in the first decade of May made up 20.1C°, quantity of fell precipitations during the decade – 16 mm (*figure 1*).

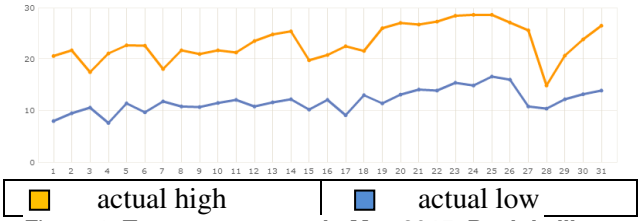

Figure 1. **Temperature graph, May 2015, Bacioi village**

As a result of carried out records was established that the first sings of scab on leaves of apple appeared in the first decade of May, which according to terms corresponded to the phase of end of blossoming – leaves fall (*figure 1 a, b*).

Many authors (Zueva I.M., 2000, 2005; Vahsheh I.N.N., 2014) note that aging of the first ascospores of scab agents most of all are observed till the beginning of opening the apple leaves. Release of the main mass of ascospores and the greatest threat of the first contamination of apple tree occur during the period of "rose bud – end of blossoming". Thus, the possibility of strong primary contaminations increases during the period of mass blossoming and soon after ending of apple blossoming. Our observations showed that the first manifestations of scab in garden were marked from May 09 till May 11, 2015 in the phase of fruits growth (8-10 cm). At that the degree of disease development (R) in testing variants was in 3-5 times lower in comparison with the chemical standard. The third treatment by bioelicitors was carried out in some days after diagnostics of the first signs of scab on plants.

The records demonstrated that already in the beginning of the second decade of May (May 20, 2015) the scab prevalence on leaves, the disease development (R) in control reached 19.1%, while in the variants with application of bioelicitors it made up only 2.0-3.5% (*figure 2*). The scab prevalence (P) in test on leaves in indicated period ranged from 14.1 to 18.7% (*figure 3*), which was significantly lower than in the chemical standard 23.4%) and in the reference (37.0%).

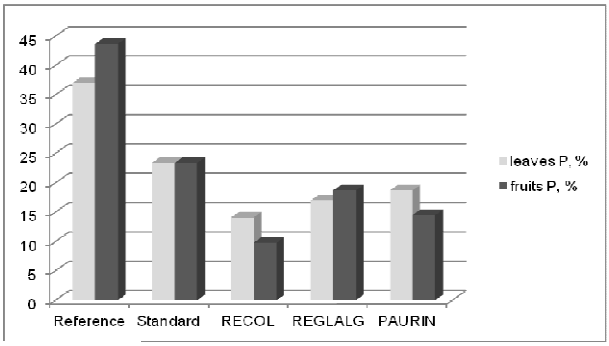

Figure 2 **The scab prevalence (P) on leaves and fruits of apple trees, Bacioi village, "AgroBrio" Ltd., 2015**

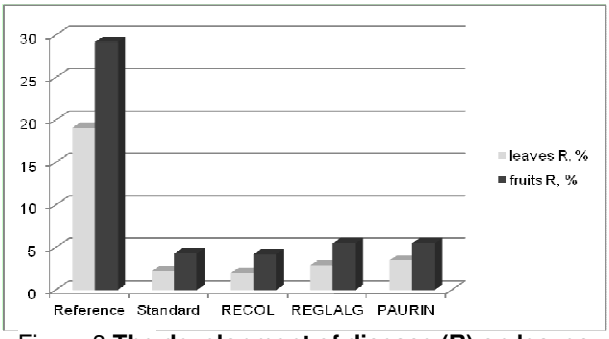

Figure 3 **The development of disease (R) on leaves and fruits of apple trees, Bacioi village, "AgroBrio" Ltd., 2015**

It should be mentioned that to the beginning of fruits aging (first decade of August) the development of disease (R) on fruits in test ranged from 4.2 to 5.5% and was comparable to the chemical standard (4.3%). In reference the development of disease on fruits reached 29.2 %. The scab prevalence (P) on fruits in test ranged from 9.8 to 18.7%, while in standard and control – 23.4 and 43.7% respectively (*figure 2, 3*).

Chlorophyll index depended on the variants: Reglalg 103; Recol 98.99 and Paurin 93.06 mg / cm^2 (standard 80.22 and reference – 68.9 mg/cm^2). The growth of shoots on the variants ranged from 19.7 to 23.2 cm (the standard – 20.7 and control – 15.7 cm) (*table 2*).

Mathematical treatment revealed some insignificant differences between tested variants, chemical standard and control, in spite of the difference in absolute values of sprouts growth. At the same time, the chlorophyll index of preparations significantly differs from the chemical standard and control (*table 2*).

Table 2

Biometric indices at application of biorational preparations on apple tree of Vagner Prizovoi variety ("AgroBrio" Ltd., Bacioi village, Republic of Moldova)

Variants	Consumption rate	Chlorophyll index, mg/cm^2	Growth of shoots, cm
Reference	-	68.90	15.7±4.6
Standard	0.3 l/ha	80.22	20.7±7.9
RECOL	8.0 l/ha	98.99	19.7±8.7
REGLALG	0.5 l/ha	103.00	20.3±6.4
PAURIN	10 g/l	93.06	20.7±8.3
		$HSD_{0.05}$= 10.2	

Biological effectiveness of preparations Reglalg, Recol and Paurin against scab made up on leaves and fruits respectively (*figure 4*).

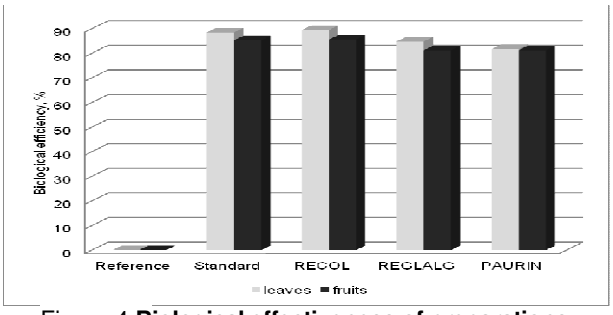

Figure 4 **Biological effectiveness of preparations Reglalg, Recol and Paurin against scab on leaves and fruits of apple trees, Bacioi village, "AgroBrio" Ltd., 2015**

Thus, we proved the capability of preparations to induce the protective functions of plants of apple tree, which was expressed in decrease of scab prevalence and development, as well as in increase of chlorophyll index.

CONCLUSIONS

In conditions of year 2015 the first symptoms of scab on apple of Vagner Privozoi variety were marked in the first decade of May – in the phase of end of blossoming (leaves fall).

Determined high efficiency of biostimulators Reglalg, Recol and Paurin (81.2 – 89.5%) against apple scab on medium-injured Vagner Prizovoi variety in years of moderate development of disease gives the possibility to reduce the chemical treatments.

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