THE EVALUATION OF THE TOLERANCE TO PESTS AND DISEASES IN *SALIX* SP. GENITORS COLLECTION IN THE FIRST GROWING SEASON

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Abstract. *In Romania, the interest for biomass production from short rotation coppice (SRC) is at beginning, being focused on the culture of poplar and willow. The high productions of biomass, which can be obtained from these cultures, are affected by numerous diseases and harmful insects, with negative effects on viability and vitality of these cultures. In order to improve the actual clones (certified for culture in Romania) resistance to biotic and abiotic stress, a collection of different provenance Salix sp. potential genitors was established in March 2015 (Didactical and Experimental Station belonging to BUASVM Timişoara). The genitors collection includes 38 genotypes collected from the spontaneous flora belonging to 11 different species of Salix. Diseases of shoots and leaves caused by Marssonina salicicola, Pollaccia saliciperda, Uncinula salicis and Cercospora salicina were registered. A negative impact on young shoots vitality had leaf beetle Melasoma saliceti L., small poplar borer (Saperda populnea) as well as sucking pests like different species of Aphidae or mites. The most tolerant genotypes both to pests and diseases were belonging to S. rosmarinifolia and S. pentandra. The most sensitive species include genitors from S. fragilis, S.alba and S.purpurea. Tolerance to pests and diseases was dependent on species and origin. The genitors will be monitored in the coming years for an accurate assessment of tolerance to diseases and pests, in different climatic conditions.*

Keywords: *Salix sp., pests, diseases*

INTRODUCTION

In Romania, the interest of biomass has increase and soft wood is expected to be one of the important sources of renewable energy. Willow short rotation coppice (SRC) for biomass production is at the beginning and is focus on using high-yielding varieties. In Romania, the interest for the exploitation and capitalization of the biomass resulted from the woody cultures type SRC is at begining, being focused on the culture of poplar and willow, with a high productive potential, slightly setting up by cuttings, with a great sprouting power, after repeated cuts (LAJOS, 2012; LEVENTE, 2012). But willows are affected by numerous diseases and harmful insects, with negative effects on viability and vitality of these cultures. Because, between clones, susceptibility to damage caused by biotic factors (diseases and insects) varies greatly, knowing these genotypes resistance to the attack of various diseases and harmful insects is of great importance. This knowledge can be the starting points for future improvement programs for willow species. Expanding the culture of clones resistant to various biotic harmful factors (bacteria, fungi, insects, etc.) can help to reduce injuries and decrease the

amount of pesticides used to control their pollution, impact on reducing financial costs and on beneficial environmental effects, maintaining at the same time, the sustained production. Experience all over the world showed that resistance to pest and diseases is under genetic control and depend on local conditions (ANSELMI, 2009). One of the main challenges is to breed varieties/clones (certified for culture in Romania) resistant to biotic and abiotic stress and this is our final goal.

The aim of the research was to assess susceptibility to disease and pests, in the first growing season, for 38 Romanian accesions, belonging to 11 species and collected from Banat and Oltenia area.

MATERIAL AND METHODS

A collection of different *Salix* sp. potential genitors established by cuttings in March 2015. (Didactic Station belonging to BUASVM Timişoara) (Lat: 45°47'5.04"N, Long: 21°12'50.36"E, Alt: 87 m), (Fig.1).

Fig 1. The location of the genitors collection

The biological material (46 cuttings for each genotype) was planted in double rows 75 cm apart with double rows spaced at 150 cm and an 80 cm in-row spacing. During the growing season was made chemical and mechanical weed control. There were not applied phytosanitary treatments, in order to test the natural resistance of the genotypes.

The genitors collection includes 38 genotypes, collected in February 2015 from the spontaneous flora (Banat and Oltenia) belonging to 11 different species of *Salix* (Table 1). The evaluation of the tolerance to pests and diseases was carried out in the growing season period (July- October) in 2015. For each genotype 46 plants were evaluated. As the first step of research, the frequency and the intensity of the disease and the pest attack was registered.

Table 1.

Salix sp. genotypes from the genitors collection

Field No.	Genitors collected from Banat	Location		Field No.	Genitors collected from Oltenia	Location	
1	*Salix fragilis*	Lat	44°46'51.13"N	20	*Salix alba*	Lat	46°36'43.43"N
		Long	21°32'51.63"E			Long	26°43'29.52"E
2	*Salix fragilis*	Lat	44°46'51.87"N	21	*Salix fragilis*	Lat	45° 02’ 13’’ N
		Long	21°32'49.12"E			Long	22° 56’ 01’’ E
3	*Salix purpurea*	Lat	44°46'52.65"N	22	*Salix alba*	Lat	45° 02’ 09’’ N
		Long	21°32'47.76"E			Long	22° 56’ 00’’ E
4	*Salix pentandra*	Lat	44°46'47.78"N	23	*Salix alba*	Lat	45° 02’ 09’’ N
		Long	21°33'2.56"E			Long	22° 55’ 59’’ E
5	*Salix purpurea*	Lat	44°41'23.54"N	24	*Salix fragilis*	Lat	45° 03’ 35’’ N
		Long	21°38'31.07"E			Long	22° 52’ 37’’ E
6	*Salix purpurea*	Lat	44°42'44.58"N	25	*Salix alba*	Lat	44^0 24’ 34’’ N
		Long	21°39'40.92"E			Long	24^0 08’ 19’’ E
7	*Salix incana*	Lat	44°53'44.35"N	26	*Salix fragilis*	Lat	44^0 24’ 38’’ N
		Long	21°41'44.58"E			Long	24^0 08’ 16’’ E
8	*Salix caprea*	Lat	44°53'44.29"N	27	*Salix fragilis*	Lat	44^0 24’ 45’’ N
		Long	21°41'44.29"E			Long	24^0 08’ 13’’ E
9	*Salix rosmarinifolia*	Lat	44°53'44.42"N	28	*Salix purpurea*	Lat	44^0 25’ 03’’ N
		Long	21°41'43.94"E			Long	24^0 07’ 25’’ E
10	*Salix rosmarinifolia*	Lat	44°53'44.58"N	29	*Salix babylonica*	Lat	44^0 25’ 03’’ N
		Long	21°41'43.83"E			Long	24^0 07’ 25’’ E
11	*Salix fragilis*	Lat	45° 5'36.51"N	30	*Salix pentandra*	Lat	44^0 25’ 03’’ N
		Long	21°41'33.15"E			Long	24^0 07’ 25’’ E
12	*Sallix daphnoides*	Lat	45° 5'36.18"N	31	*Salix triandra*	Lat	44^0 37’ 02’’ N
		Long	21°41'32.57"E			Long	23° 58’ 23’’ E
13	*Sallix daphnoides*	Lat	45° 5'37.09"N	32	*Salix fragilis*	Lat	44^0 39’ 33’’ N
		Long	21°41'33.57"E			Long	23^0 54’ 30’’ E
14	*Salix caprea*	Lat	45° 5'36.92"N	33	*Salix alba*	Lat	44^0 50’ 58’’ N
		Long	21°41'35.22"E			Long	23^0 16’ 51’’ E
15	*Salix cinerea*	Lat	45° 5'36.10"N	34	*Salix pentandra*	Lat	44^0 50’ 58’’ N
		Long	21°41'38.25"E			Long	23^0 16’ 51’’ E
16	*Salix purpurea*	Lat	45° 7'0.32"N	35	*Salix alba*	Lat	44^0 52’ 34’’ N
		Long	21°46'53.78"E			Long	23^0 12’ 16’’ E
17	*Salix alba*	Lat	45° 7'2.93"N	36	*Salix fragilis*	Lat	44^0 52’ 34’’ N
		Long	21°46'51.32"E			Long	23^0 12’ 16’’ E
18	*Salix caprea*	Lat	45° 7'0.82"N	37	*Salix fragilis*	Lat	44^0 52’ 34’’ N
		Long	21°46'52.26"E			Long	23^0 12’ 16’’ E
19	*Salix fragilis*	Lat	45° 6'58.25"N	38	*Salix purpurea*	Lat	44^0 51’ 20’’ N
		Long	21°46'54.05"E			Long	23^0 09’ 24’’ E

*in text we will referee to any genitors by putting the correspondent number in brackets[ ]

RESULTS AND DISCUSSIONS

The disease that affect the leaves, stem or roots has to be considered in developing sustainable willow cropping systems for energy as mention OSTRY ET AL., 2014.

The main diseases that have come forward with great frequency, but the low intensity were: *Marsonnina salicicola* Magnus., and *Pollaccia* (*Fusicladium*) *saliciperda* Arx. A lower frequency presented *Cercospora salicina* Chupp & H.C. Greene and *Uncinula salicis* [DC]

Winter, all of them being diseases of the leaves and shoots (Fig.2). None of the diseases that affect roots or stem were observed in the first growing season.

Fig. 2. The main diseases observed in *Salix* sp. genitors collection: a. *Pollaccia* (*Fusicladium*) *saliciperda*, b. *Cercospora salicina*, c. *Uncinula salicis*, d. *Marsonnina salicicola* Magn.

Marsonnina salicicola (Fig. 2d), causes anthracnose on *Salix* and it is widespread in Europe, North and South America, New Zeeland (SPIERS, A. G.,1998). Little spots on leaves causing early defoliation, withering of the shoots and weakening of the tree, are the specific symptoms (ANSELMI, 2009). The most genotypes of *S. alba*, *S. fragilis*, *S. purpurea* and *S. babylonica* are susceptible, the frequency (F) of *M. salicicola* attack was over 80%, most of the sensitive genitors belonging to Oltenia. In the same time there were species that didn't presented any symptoms of the disease: *S. pentandra*, *S.rosmarinifolia*, *S. caprea.* PREDA ET AL (2013) reported also low to middle attack intensity for *M. salicola* in a culture of Romanian and foreign clones of *Salix sp*., in the conditions of Vâlcea County, Romania. Due to the fact that the best control measure for this disease is the use of resistant clones to establish the culture (OSTRY ET AL., 2014), the genotypes from the genitors collection should be monitored in the coming years , for the selection of the resistant ones.

Pollaccia (*Fusicladium*) *saliciperda* (Fig. 2a) causes necrosis of the leaves and young shoots in spring, often with complete defoliation (ANSELMI, 2009) and infects 28 host taxa, including hybrids (SCHUBERT ET AL., 2013). The studied genotypes presented in general a low attack, beeing affected only few leaves/plant. The most susceptible genotypes that presented a low to medium attack were *S.incana* [7] (F=71.4%), *S. purpurea* (F=20 % [3]; F=66.7 % [6]), *S.alba* (F=7.4% [33]; F=66.7% [22] (Fig. 3). The genotypes of *S.fragilis* and *S.caprea* were less affected by the disease. The genotypes belonging to Banat area were most susceptible, that the ones from Oltenia. Ruszkiewicz-Michalska and Polec (2006) in a study on the distribution of *Fusicladium* genus in Poland, mention only *S.babylonica* and *S. americana* as reported host in this country.

Cercospora salicina (Fig.2b) causes circular spots on leaf initially pale to brown, later the centre became dark brown or black surrounded by a red to reddish-brown line. In the studied genotypes the attack was of low intensity, at all affected plants. The only specie with a significant frequency of attack was *S. rosmarinifolia* (47.6-48.4%). Any simptoms of this disease has not occured in most of the genotypes. There was two exception, genotype 23, *Salix alba* and genotype [24] *S. fragilis*, where the frecvency of the dissease was less than 10% (Fig. 3).

Uncinula salicis, powdery mildew causes foliar infections, easy to recognized due to the white powder, which finally cover the leaf (Fig. 2c). At a severe attack the young shoots are also affected. It's a disease widespred in Europe, North and South America. There is not considered a thretness for SRC willow. The genotypes *S.alba* [20] and *S.daphnoides* [10] were the most susceptible with a frequency of 37.5% and 20.0% respectively (Fig.3). The attack intensity was low for all affected genotypes.

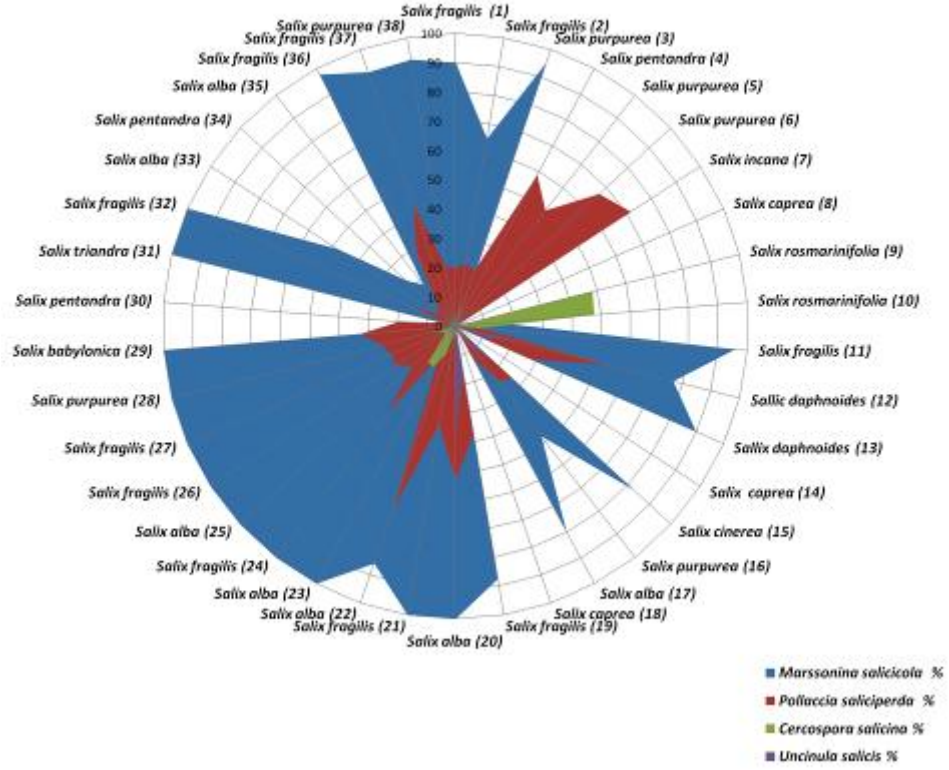

Fig. 3 The frequency (%) of the disease attack in *Salix* ssp. depending on genotype, in the first growing season (2015)

Rust (*Melampsora* spp.), that is the most serious disease on willow crops in Europe (ROYLE AND HUBBES, 1992; OSTRY ET AL., 2014), causing premature defoliation and loss of yield was not observed in the Romanian analysed genotypes. The same observation was made by BOTU ET AL. (2013) in the conclusions of a three years trial with romanian and swedish cultivars remarked that romanian cultivars proved less susceptible to leaf rust.

A large number of insect species has *Salicaceae* host, but less than 10% can be considered pests due to the major damage produced (CHARLES ET. AL, 2014). Harmful insects, which presented a high frequency attack in some of the genitors were: *Melasoma saliceti* Suffrian, *Saperda populnea* L. (Figs. 4, 5). Damages were also produced by mites or phytophagus acariens (*Schizotetranychus zchizopus* Zacher). There were noticed also plants with *Pontania maxima* Hart. galls, isolated *Plagiodera versicolor* Laich. or *Chalcoides spp*. individuals.

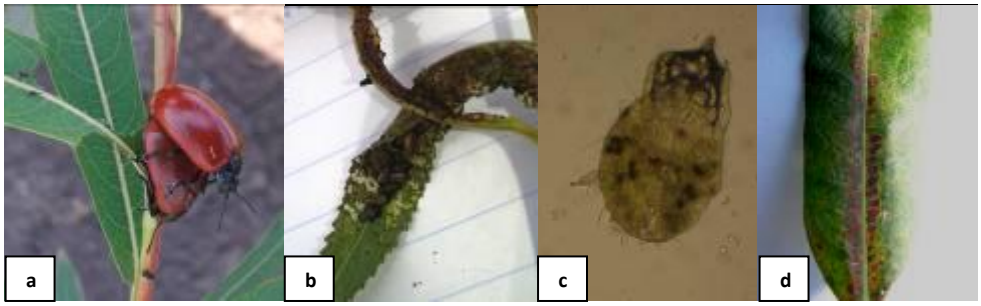

Fig.4. The main pests observed in *Salix* sp. genitors collection in the first growing season (2015) *Melasoma saliceti*. Adults (a) and larves (b), *Schizotetranychus schizopus* Zacher. Adult mite (c) and aspect of the attack (d).

Melasoma saliceti (Fig 1a, b) is a defoliator, both the adults as well as the larvae being leaf eaters. The specia is widespread in Europe and Asia (GRUEV, 2004). The timing of attack is important for the consequences on plant vitality. Spring attacks are not so dangerous like summer ones, which can produced dramatic loss in productivity (CHARLES ET AL., 2014). In 2015 there were observed two generations, one in June-July, with a low intensity attack and the second in September with a middle intensity attack. The most susceptible genotypes belonging to *S. fragilis* and *S. alba*, the highest frequency 69-70% being recorded in genotypes [24], [26], [27], all of them collected from Oltenia. In the rest of the genotypes the damages were insignificant.

Adult spider mites (*Schizotetranychus schizopus* Zacher) (Fig.4c) cause damage by sucking out the cellular juice. At first, light dots occurred on the leaves then, these become shiny brown (Fig. 4d) and the photosynthesis is reduced. The frequency of the attack was higher in *S. babylonica* (F=100.0%) and *S.pentandra* (F=37.9-100.0%). A large variability of the susceptibility to spider mites attack presented *S. fragilis* where was found a resistant genotype [1] (F=0%), while another genotype [32] was attacked 100%. This food preference of mites in specific genotypes of willow was reported also by Skorupska (2012) in an experiment with 12 basket willow varieties growing in Poland. Elma and Alaoğlu (2008) in their study on harmful mite species mentioned that *S. schizopus* attack not only Salix sp., but also *Quercus* sp.

Adults and larves of *Saperda populnea* damage willow stems. Adult female laid a single egg in each horse shoe-shaped depression cut into the bark through to the sapwood. On the first stage larvae feed on the wounded tissues induced during egg lying then bores a horizontal tunnel towards the centre of the tree. Like a result the resistance of willow steams and plant vitality is going to be lower; this insect act like a vector for xylophagus fungal disease (TOMESCU AND NETOIU, 2009). Genitors culture being in the first growing season, the pest produced insignificant damages, even characteristic simptoms of attack were observed.

The obtained results demonstrated that the frequency of the disease and pest attack is dependent on genotype and the genetic structure of the specie is important in damages control. All these results from the genitors collection will be very helpful in a future Romanian willow breeding program. The results are in concordance with the opinion of TOMESCU AND NEF (2007) who after experiments carried out under varied planting regimes have shown clearly that the severity of insect attacks is linked to genetic factors that determine either physical or chemical defences in trees.

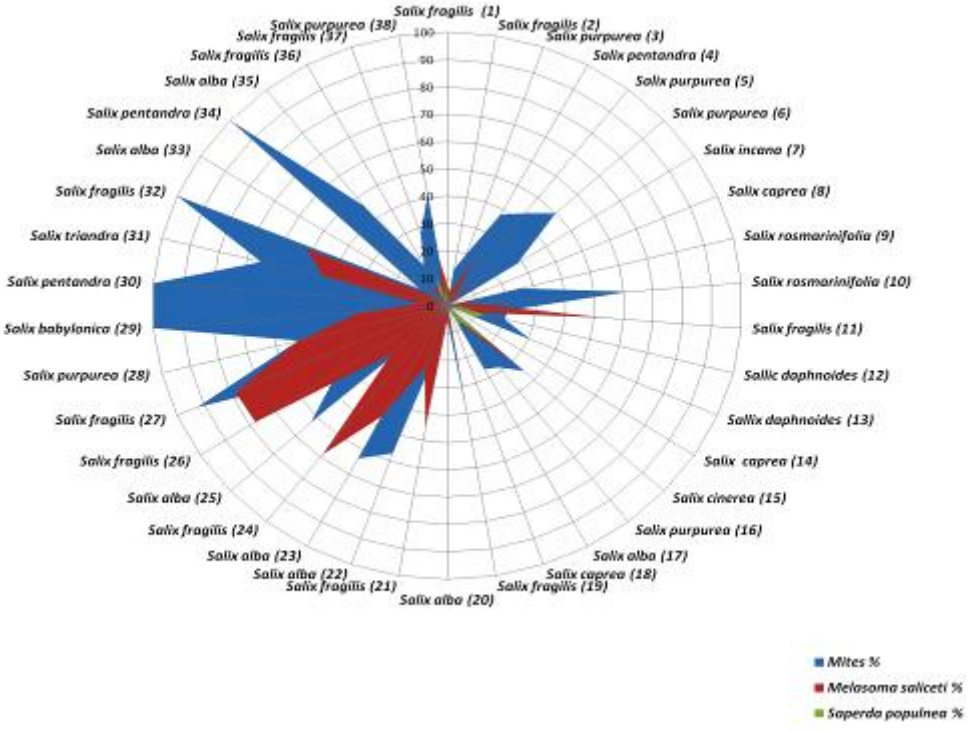

Fig 5. The frequency (%) of the pest attack in *Salix* ssp. depending on genotype

CONCLUSIONS

In the climatic conditions of the year 2015, most of the *S. fragilis, S. purpurea* and *S. alba* genotypes were susceptible to *Marsonnina salicicola* infection. The intensity of the infection was medium. All genotypes were quite resistant to *Uncinula salicis*.

Pest cause also damage in *Salix* sp.. *Melasoma saliceti* produced damages only in *S. fragilis* genotypes. Some of the *S. pentandra* and *S. fragilis* genotypes registered the highest attack frequency by phytophagous mites.

The *Salix* sp. genotypes colected from Banat area are more resistant to diseases and pests attack than the ones collected from Oltenia area.

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