

HIGHLIGHTING GENETIC PROGRESS IN IMPROVING WINTER RYE

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Abstract *This paper highlights the contribution of winter rye culture, initially by testing and identifying the most suitable local populations and foreign varieties, and subsequently through the creation, introduction and widespread in the production of Gloria, Orizont, Ergo and Suceveana varieties, obtained at A.R.D.S. Suceava.*

During the 1951-1955 stage, certain local landraces and the cultivar Petkus registered an average yield on 1300 kg/ha, and during period 1970-1975 the average yield of the cultivars Danae and Dankovskie Zlote grows at the 3160 kg/ha.

The cultivars Danae, Dankovskie Zlote and Ianoși during period 1976-1985 registered an average yield on 4207 kg/ha, and during 1986-1995 the cultivars Gloria, Ergo and Orizont which were created at the A.R.D.S. of Suceava had an average yield on 4980 kg/ha.

The cultivar Suceveana was cultivated during 1996-2005, with an average yield on 5075 kg/ha. The superiority of the four cultivars: Gloria, Orizont, Ergo and Suceveana from the productivity and yield stability point of view, was statistically demonstrated through the distribution of the correlations and variance of productions in comparison with the standard cultivars from the above periods.

The superior values of the quality traits recommend the utilization of the rye cultivars which were created both for bread making feature and for fodder users.

Key words: *cultivars, breeding, yield, quality, resistance.*

1. INTRODUCTION

Although there has lately been registered a considerable restraint of the cultivated surfaces, the autumn rye crops still marks a wider spreading, not only in the submountaneous and hilly areas, but also in the areas with a wet and cold climate, where there still can be found podzolic and podzolic soils, with an increased acidity and a reduced natural fertility, and in the areas with sandy land, from the south and western part of the country, with a short and irregular pluviometrical regime [1]. The restraint of the cultivated areas has happened because of the involution of the researched in the domains of genetic and breeding, as a follow up of non-financing

of the agricultural research, and of the profound changes too, that have come to recently in the structure of the territorial fond, that determined the productive potential of the rye to be decreased in comparison with the one of the wheat and barley [2]. Thus, in our country, the rye advanced cultivars sorts, is reduced in comparison with the other cereals [3]. Because the level of the rye productions is frequently affected by the decreased resistance to lodging, as a follow up to the still high enough height of the species, by the sensibility to the diseases attack, especially to the snow mould, that presents a great danger for the cultures, in the wet and colder areas and also the insufficient resistance to the seed germination in the spike, there has appeared the necessity of

creating new cultivars, superior from the agronomic point of view in comparison with the cultivated varieties in the past time [4].

The production components are closely related to their genetic stability. The components with high genetic stability are: the grain's weight, the ear's density, the number of small parts from an ear [5].

The ear's length and the number of grains from an ear present a medium stability and the number of fertile brothers, the grains weight from the ears, the number of grains from the ear and the number of grains from the plant presents a low stability [6].

Through the development of the genetic and breeding researched there have

2. BIOLOGIC MATERIAL AND RESEARCH METHOD

The breeding work carried out so far for the autumn rye have had a great contribution to the identification of the local populations and the foreign cultivars, to the creation of autochthon lines and the extension in the culture of the most valuable of these, but, in the second half to the creation of four cultivars, and also to the obtaining of a more valuable breeding material, with a shortened height, well adapted to the specific conditions of the rye culture, that can be used for the creation of more advanced genotypes.

- The evaluation of the superiority of the cultivars and the lines presents itself during three significant periods of time that are:

- 1. 1946-1975 period** highlights the experimental results of the cultivars and the rye lines verified at A.R.D.S. of Suceava, from the point of view of the physiological features, quality features and productivity features in comparison with the Petkus cultivar;
- 2. 1976-1995 period** highlights the productive value not only of the

been created not only superior rye cultivars, resistant to lodging, to diseases and less favorable climatic conditions that could face the culture on fields with a reduced fertility and following perfection technologies, and also new lines with a genetic determinism dominant for the short height of the straw [7].

This paper aims at appreciating the contribution brought to the rye culture, initially through the testing and identification of the most appropriated local populations and foreign cultivars and afterwards through the creation, introduction and extension in the production of the obtained cultivars at A.R.D.S. of Suceava.

Gloria cultivar but also of the Sv. 2546-78 and Carpați lines, created in this period and that were to become cultivars, in comparison with the Dankovskie Zlote cultivar used as a standard in this period ;

- 3. 1996-2005 periods** presents the value of the Gloria, Orizont, Ergo, and Suceveana cultivars but also the achievements in the direction of creating short straw forms, in comparison with the standard Orizont, which is the tallest.
- 4.** The cultivars and the experimented lines have been appreciated during time, under the aspect of physiological features, quality and production features, using the results obtained in the comparative crops, during the experimental years, in comparison with the standards Petkus and Dankovskie zlote, that had the greatest spread in the production, but also with the Orizont cultivar, created in Suceava, even though it has not occupied significant areas, is the national cultivar with the greatest height of plants. The correlation between the results of the created cultivars in Suceava and the ones of the

standard cultivars Dankovskie zlate and Orizont in the periods 1986-1995 and 1996-2005 has been highlighted through the calculation of the linear regressions, and the stability of the productions has been marked through the determination of the variances (s^2). The phenological observations made during the vegetation over the main physiological features are presented in the work through medium values and the interpretation of the production data has been carried out through statistic methods of variance analyses [8].

The experimentation has been carried out in comparative crops, executed at the beginning, after the method of plots position in Latin rectangle (with 5 replications and 10 m² the cropped surfaces of one plots) and then in the simple grating (3 replications and 7 m² cropped plot).

In majority of the experimented years the cultures have been placed after potatoes, in a leached chernozem soil, rich in humus

and total nitric, provided with phosphor and mobile kalium, not being necessary the fazial fertilization in autumn, as the potato has received larger quantities of chemical fertilizer. In spring, before the beginning of vegetation period, there have been administered 40-70 kg N s.a. /ha as ammonium nitrate or nitrocalcar.

The sowing has been carried out, in the big majority of the experimental years, in the optimum epoch for this area being assured on 500 germinated grains/ m²[9].

For creation at A.R.D.S. of Suceava of the four cultivars and 5 more valuable lines, with a genealogy and obtaining method, that will be briefly presented, there has been used valuable genetic resources, combining not only genes from the European germplasm, included in the hybrid population through the Polish and German cultivars, of high productivity, and also different ecological genes, from the national germplasm fond, included through the inbred lines characterized by a short height and an increased resistance to falling and diseases (*table 1*).

Table 1
Genealogy and obtaining method of cultivars and inbred lines created at A.R.D.S. of Suceava

Cultivar or line	Parental forms	Cross year	Homologated year	Selection method
Gloria	Canorus x Danae	1974	1983	Selection on families
Orizont	(L.C.4415 x Danae)xPetkuser kurzstroh	1975	1988	Mass selection
Ergo	Pecuro x (Dankovskie zlate x Danae)	1974	1988	Selection on families
Suceveana	(Dankovskie zlate x Sv.623-83) x Lad 185)	1988	1996	Selection on families
Sv. 90 - BI	(Orizont x Borellus) x Borellus	1988	-	Selection on families
Sv. 21 - 90	(Ensi x Ergo) x E.M. - 1 pollinated	1986	-	Mass selection
Sv.4 - 2 - 90	(Ergo x Borellus)x Dankovskie zlate	1987	-	Selection on families
Sv. 90 - EM	EM 1 - repeated open pollinated	1986	-	Mass selection
Sv. 90 - CP	Ciulpan - repeated open pollinated	1986	-	Mass selection

3. RESULTS AND DISCUSSIONS

The breeding researches for the winter rye begun after year 1950, in short time, after the foundation of the ARDS of Suceava, through the checking of the behavior of the different local population and foreign cultivars in the crops conditions from the western part of the Suceava Plateau have

been a precursory stage for the systemized organization and the amplifying of the breeding work for the rye, that have been developed after 1970, appreciating that, once with these, the crop of the winter rye, and of the other plants from this area, have registered on an ascendant trajectory.

In this paper we present the dynamic of the cultivars number and the experimented lines during 6 decades, so that, beginning

with year 1946 until 2005, there have been checked, in comparative crops, from the point of the vegetation behaviour and productivity views a number of 3116 cultivars and rye lines, from which, 759 national and foreign cultivars. The most

valuable among these cultivars have been introduced and generalized in the production, occupying significant surfaces at the level of the three distinct periods. (table 2).

Table 2

The volume and dynamic of the breeding researches at the winter rye during period 1946 – 2005 in ARDS of Suceava

The research specification and obtained results	Period:			Total 1946 - 2005
	1946 - 1975	1976 - 1995	1996 - 2005	
The study of the cultivars and lines in the comparative crops	368	2 153	595	3116
- cultivars	57	510	192	759
From which :				
- lines	311	1643	403	2357
The cultivars and inbred lines considered valuables	Local populations Petkus breded Petkus Harrach Visa Danae Dankovskie zlate	Dankovskie zlate Danae Ianoși Pluto Gloria Orizont Ergo Sv. 4 - 2 - 90 Sv. 92 - A Sv. 92 - R Sv. 185 - 90	Gloria Orizont Ergo Suceveana Sv. 90 - BI Sv. 21 - 90 Sv. 90 - EM Sv. 921 - 97 Sv. 90 - CP Sv. M. 72 - 98 Sv. 200 S -99 Sv. 300 S - 99	
From which: introduced and generalized in crop production	Petkus breded Petkus Danae Dankovskie zlate	Danae Dankovskie zlate Ianoși Gloria Orizont Ergo	Gloria Orizont Ergo Suceveana	

1. 1946-1975 period has been characterized through the experimentation of a number of up to 368 local populations, native and foreign cultivars and inbred lines, from which some inbred lines created at ARDS of Suceava, have been highlighted, from the point of view of the physiological and productivity features.

The quality of the production

Concerning the physic and chemical features of the production we can notice that this represents different values from a genotype to another. So, the hectoliter mass has registered middle values, from

64.8 kg at cultivar Harkovskaia 60 to 69.5 kg at line Sv. 25-65 and one thousand kernel weight oscilated between 29.1 g at Panterne cultivar and 33.2 g at Dankovskie zlate cultivar.

Differences between the cultivars and the experimented lines have been noticed also concerning the chemical features, these having values for the protein content comprised between 11, 5% at Danae cultivar and 13.5% at line Sv 32-66 and for starch content, between 58.2% at Petkus cultivar and 61.4% at Harkovskaia 60 cultivar (table 3).

Table 3
The physic and chemical traits of production for the rye cultivars and lines experimented during 1970-1975 at ARDS of Suceava

Nr. crt.	Cultivar or line	Test weight(g)	One thousand kernel weight	At dry substance:	
				protein content (N x 5,7) %	starch content %
1	Petkus - st	67.2	30.5	13.4	58.2
2	Danae	66.3	30.8	11.5	61.3
3	Harkovskaia 60	64.8	30.9	11.7	61.4
4	Desneanka 2	65.2	30.4	13.4	58.3
5	Panterne	67.7	29.1	12.5	60.6
6	Dankovskie zlate	67.9	33.2	12.8	60.8
7	Sv. 11 – 65	69.3	30.8	13.2	59.1
8	Sv. 25 – 65	69.5	31.2	12.8	60.1
9	Sv. 17 – 65	68.8	31.4	13.4	58.5
10	Sv. 5 – 65	68.6	31.0	12.9	58.8
11	Sv. 3 – 65	69.2	31.3	12.7	60.2
12	Sv. 6 – 65	69.3	30.5	12.3	60.4
13	Sv. 32 – 66	67.4	29.9	13.5	58.3

2. 1976-1995 period emphasized the value of the cultivars and the lines created in Suceava during this time, from the point of view of the physiological, quality and production traits in comparison with the standard cultivar Dankovskie zlate.

The yield quality

Concerning the quality features of the production we can notice that between the cultivars and the experimented lines during 1981-1985, there have been differences (table 4).

Table 4
The quality traits of the production for the rye cultivars and lines experimented during 1981–1985 at ARDS of Suceava

Nr. crt.	Cultivar or line	Hectoliter mass - kg -	One thousand kernel weight - g -	At dry substances:	
				% protein content	% starch content
1	Dankovskie zlate – st.	67.4	34.3	13.1	61.5
2	Danae	66.2	35.1	12.5	60.3
3	Ianoși	67.8	34.9	11.5	62.5
4	Voshod 1	67.5	34.7	12.0	65.7
5	Pluto	68.7	33.9	12.2	64.3
6	Golubka	65.3	36.2	12.4	61.2
7	Dorna	67.9	35.3	12.8	61.0
8	Prima	67.6	35.6	12.3	62.0
9	Dragomirna	68.8	34.5	11.7	62.5
10	Gloria	68.7	36.6	13.4	62.1
11	Sv.2546–78	68.5	35.4	12.8	64.2
12	Carpați	69.6	33.2	12.7	61.4

The test weight has registered in this period medium values from 65.3 kg at Golubka cultivar to 69.6 kg at line Carpați and one thousand kernel weight between 33.2 g at line Carpați and 36.6 g at line Sv. 2546–78.

From the point of view of the chemical traits, also, there are differences between

the cultivars and the experimented lines, concerning the protein and starch contents. The brute protein content, reported to the dried substance, has oscillated in relatively large limits, from 11.5 % at cultivar Ianoși to 13.4 % at cultivar Gloria, and starch content registered values between 60.3 %

at cultivar Danae and 65.7 % at cultivar Voshod 1.

3. 1996-2005 period is characterized by progresses registered in the direction of creating new forms with short straw, with a big productivity and improved resistance to the plant lodging

The yield quality

From the point of view of the physics and chemical features of the production we can notice that the new genotypes experimented during 1996-2005, have proved different values (table5)

Table 5
The physic and chemical traits of the production for the rye cultivars and lines experimented during 1996 – 2005, at ARDS of Suceava

Nr. crt.	Cultivar or line	Hectoliter mass - kg -	One thousand kernel weight - g -	At dry substances:	
				% protein content	% starch content
1	Orizont – mt.	69.8	42.1	12.4	60.2
2	Gloria	71.5	40.6	12.7	60.9
3	Ergo	72.2	38.8	12.1	61.2
4	Suceveana	69.5	42.5	13.3	61.5
5	Dankovskie zlate	68.3	41.0	12.9	59.9
6	Amando	70.2	39.8	12.4	60.4
7	Sv. 90 – Bl.	69.1	42.7	12.9	62.5
8	Sv.21 – 90	68.1	43.0	11.9	63.1
9	Sv. 90 – EM	71.2	38.9	12.6	62.2
10	Sv. 90 – CP	71.0	39.1	13.5	61.1
11	Sv. M 72 – 98	71.1	39.2	12.6	62.5
12	Sv. 921 – 97	69.5	42.8	12.2	64.2
13	Sv. Im – 98	70.4	40.0	12.5	59.6
14	Sv. 200 S – 99	71.0	39.8	12.9	60.6
15	Sv. 300 S – 99	70.5	40.5	13.1	65.1

In this period the tests weight has registered, function by climatic and crop conditions, the higher middle values, from 68.1 kg at line Sv. 21 – 90 to 72.2 kg at Ergo cultivar and one thousand kernel weight has oscillated between 38.8 g at Ergo cultivar and 42.8 g at line Sv. 921 – 97.

Regarding the chemical features, the cultivars and the experimented lines have been differenced for the protein content between 11.9 % at line Sv. 21 – 90 and 13.5 % at line Sv. 90 – CP, and for starch content, between 59.9 % at Dankovskie zlate cultivar and 65.1 % at line Sv. 300 S – 99.

This work reveals the fact that at ARDS of Suceava there have been made sustained

researches on a long period of time in the domain of the winter rye breeding, over the great cultivars and diversified ones.

These researches have aimed at the creation of a valuable material in the direction of shortening the straw for this plant, together with the more detailed acknowledgement of the behavior of the cultivars and the lines in the conditions of the crop production [10]. So, there have been highlighted the most valuable and better adapted genotypes, which, through their introduction and generalization in the crops have contributed to the continuous spreading of the production in the northern and north-western part of Moldavia.

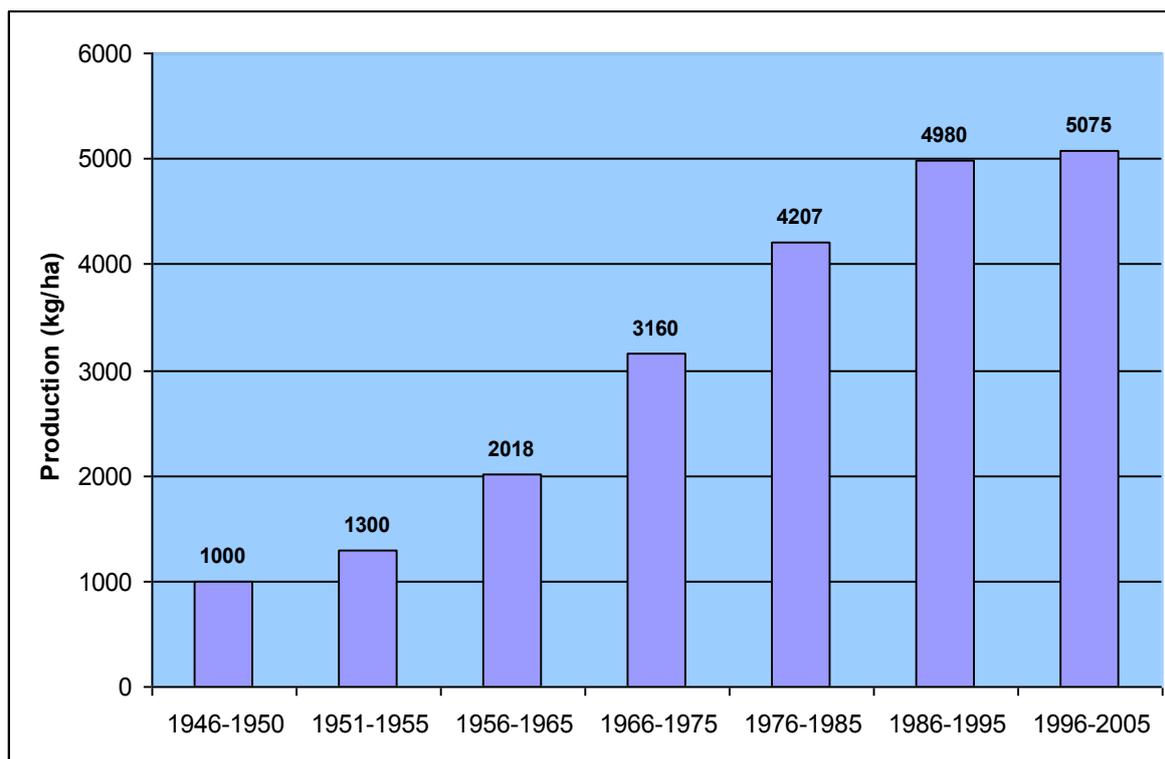


Fig. 1 The genetic progress realized for the winter rye, in period of time 1946-2005, through utilization in the crop of the most valuable cultivars, in the crop conditions offered by ARDS of Suceava.

The genetic progress reflects especially in the increase of the production capacity, registered especially in the last 40 years (1966-2005), when as a follow to the intensification of the creation of new

cultivars works, the rye productivity has greatly increased, from a middle level of 3160 kg/ha during period 1966-1975, until 5075 kg/ha during period 1996-2005.

4. CONCLUSIONS

► At ARDS of Suceava, during 1946–2005 have been carried out researches, initially in the direction of identification of foreign cultivars and more valuable and afterwards for the creation of new cultivars and rye lines with a short height, more productive and better adapted to the crop conditions from the north of Moldavia, that have contributed to the introduction, rational arrangement and generalization in the crop of the best cultivars of rye and from this to the progressive increase of the yield capacity. Through utilization in the crop culture of the most valuable rye cultivars has registered a genetic progress, that, reported to the period 1951–1955, can

be dimensioned during period 1996-2005 through an yield increase on 290 %.

► On the basis of the researches carried out during time at ARDS of Suceava there have been created 4 winter rye cultivars: Gloria, Orizont, Ergo and Suceveana, with an increased productive potential, resistant to crop lodging and better adapted to the specific crop conditions for the wet and cold areas.

► There have been registered, also, obvious achievements concerning the breeding of the physiological and the quality traits:

- the wintering resistance and diseases attack resistance, especially to the snow mould has been improved from sensitive forms to resistant forms;
- the crop lodging resistance has been increased, from very weak to very good, through the creation of cultivars and

lines with short plants height and the thick straw;

- The superior values of the quality traits recommend the using of the rye cultivars created at ARDS of Suceava, not only for the bread making features, but also fodder.

► The winter rye cultivars that find themselves at this moment in the variety cultivated in Romania, unlike the northern and north western part of Moldavia, but also in the areas with podzolic and sandy soils, are valuable cultivars, with a large ecological adaptability, and until the creation of better new genotypes we recommend in the future the cultivation of the Gloria, Orizont, Ergo and Suceveana cultivars.

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