

## MORPHOLOGICAL AND PHENOLOGICAL DIFFERENCES BETWEEN THE TWO SPECIES OF THE *PHASEOLUS* GENUS (*PHASEOLUS VULGARIS* AND *PHASEOLUS COCCINEUS*)

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**ABSTRACT** – During the vegetation period, some differences were found between the two species as concerns morphological, physiological and phenological traits. Under conditions of year 2008, in the experimental field of the Gene Bank of Suceava, the samples of *Phaseolus coccineus* L. species raised, flowered and fructified 2-30 days earlier than the samples belonging to *Phaseolus vulgaris* L. species. Although it behaved like an early species in the experimental field, *Phaseolus coccineus* L. reached maturity 8-15 days later than *Phaseolus vulgaris* L. species. This fact was explained by high rainfall amounts and low temperatures recorded in September 2008. Although *Phaseolus coccineus* L. species was cultivated in the past as ornamental plant, today it is cultivated in Romania for food, almost exclusively in the peasants' households from the mountainous area.

**Key words:** factors of biotic stress, phenological descriptors, morpho-physiological descriptors

**REZUMAT** - Diferențe morfologice și fenologice dintre două specii ale genului

*Phaseolus* (*Phaseolus vulgaris* și *Phaseolus coccineus*). În cursul perioadei de vegetație s-au înregistrat diferențe între cele două specii la nivelul însușirilor morfologice și al celor fiziologice sau fenologice. În câmpul experimental al Băncii de Gene Suceava, probele speciei *Phaseolus coccineus* L. au răsărit, înflorit și fructificat, în condițiile anului 2008, cu două până la 30 de zile mai devreme decât probele aparținând speciei *Phaseolus vulgaris* L. Deși s-a comportat ca o specie timpurie în câmpul experimental, *Phaseolus coccineus* L. a ajuns la maturitate cu 8 până la 15 zile mai târziu decât specia *Phaseolus vulgaris* L., aceasta punându-se pe seama precipitațiilor ridicate și a temperaturilor scăzute, înregistrate în luna septembrie 2008. Deși, în trecut, specia *Phaseolus coccineus* L. a fost cultivată ca plantă ornamentală, în prezent, la noi în țară, este cultivată pentru alimentație, aproape exclusiv în grădinile țărănești din zona de munte.

**Cuvinte cheie:** descriptori fenologici, descriptori morfo-fiziologici, factori de stres biotic

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## INTRODUCTION

The *Phaseolus* genus includes 150 species, of which most of them are found in the tropical areas of the American continent. The word *Pháselos* = boat (from Greek, because the bean has the shape of a boat) was used by Dioscorides and Aristophanes for *Vigna sinensis*, and was changed in Latin denomination for *Phaseolus* genus. *Phaseolus coccineus* L. species has the common name of runner bean and also belongs to *Phaseolus* genus, next to other species, of which the most important one is *Phaseolus vulgaris* L. (common bean) (Săvulescu, 1957). Although less studied in Romania, *Phaseolus coccineus* has a special importance, due to its usage as germplasm source, with application in the genetic breeding. In Romania, this species is of low economic interest, being grown more in peasants' gardens, but the world pays a special interest in it, being grown on large areas in Central America, South America and Europe. The practical importance of this species for plant and vegetable growing was shown by Munteanu (1985).

The common bean (*Phaseolus vulgaris*) is one of the most important food plants, cultivated in Romania on a large scale. Due to its high content in proteins (15%), starch (80%), fats (2%), etc. and to its conservation opportunities, bean is a valuable food (Kay and Daisy, 1979). Some parts of the plant have also a therapeutic action.

Compared to *Phaseolus vulgaris* L. species, *Phaseolus coccineus* L. has a high allogamy and likes the wet and cool climate. Although, in the past, it was cultivated as ornamental plant, today it is cultivated in Romania for food, almost exclusively in the peasants' households from the mountainous area.

The scientific paper shows the main morphological traits of the two species and the differences between them, determined in 2008 at the Gene Bank of Suceava.

## MATERIALS AND METHODS

As biological material, we have used nine samples of common bean belonging to *Phaseolus vulgaris* L. and nine samples of runner bean from *Phaseolus coccineus* L. species, all of them originating in the Maramureş County. The 18 samples were sown on a cambic chernozemic soil (3-5% humus) in the experimental field of the Gene Bank of Suceava, in randomized blocks with the row length of 2 m and the distance between rows of 0.70 cm.

For pointing out the morphological and phenological differences, we have determined the following descriptors in field and laboratory (IPGRI, 2001):

**Morpho-physiological descriptors:** number of ramifications, leaf colour, growth vigour, flower colour, pod length and width, number of pods per plant, grain colour, grain length, width and thickness, number of grains in a pod, growth vigour and resistance to biotic stress factors;

**Phenological descriptors:** way of raising, date of sowing, date of raising, date of appearance of unifoliate leaves, date of appearance of trifoliate leaves,

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date of flowering, date of first pod formation and date of harvest.

In the literature, there is the following information on the morphological and agronomical traits of the two analysed species:

*Phaseolus vulgaris* has a fusiform, weakly developed root, with nodosities. The stem is high (0.3-7 m), at its base is round and in its upper part, is hexagonal. The simple, opposite primary leaves have an oval shape, the other leaves of the stem are trifoliate and the middle foliole is wider and symmetrical, while the lateral ones are narrow and asymmetric. The inflorescence is a pauciflor raceme shorter than the leaves. The colour of flowers is various, from pink-white to violet and their size is comprised between 1 and 1.8 cm, while the pollination is autogamous. The fruit is linear or oblong. The seeds have different sizes, from 11 to 15 mm length, 5-8 mm width and 5 mm thick. The 1000-grain weight is comprised between 200 and 500 g. Cotyledon emergence is epigeous. The main chemical components of *Phaseolus vulgaris* L. mature grains are 24.3% protein, 63% carbohydrates, 1.8% fats, 3.8% fibres and 4.9% ashes (Muntean, 1995).

*Phaseolus coccineus* has a tuberized taproot, rich in starch, with nodosities and vegetative buds in the zone of neck. The 2-7 m stem is high, vigorous and slightly twisted. Leaves are trifoliate, with oval folioles, acuminate to their

peak and round at the base. The inflorescence is zygomorphic, hermaphrodite, multiflor raceme longer than the leaves, of 25-35 cm, with red, white, pink, bicolor flowers and allogamous, seldom autogamous pollination.

The fruit is linear oblong to oblong. Seeds are great, of 20-25 mm long, 13-14 mm wide and 8 mm thick. They have different colours: white, black, beige and violet. The 1000-grain weight is between 1000 and 1400 g. Cotyledon emergence is hypogenous. The main chemical components of the mature grains from this species are 20% protein, 63% carbohydrates, 1.5% fats, 5% fibres and 3.5% ashes (Kay, 1979).

## RESULTS AND DISCUSSION

The analysis of climatic conditions from 2008 showed that the mean monthly temperatures had high variations, their mean has progressively increased from 13.7°C in May to 20°C in August, showing a sudden diminution in September (13°C). In comparison with the multiannual mean, we noticed that rainfall had higher values during the vegetation period, with excess recorded in July, compared to the multiannual mean of rainfall in that month (*Table 1*).

**Table 1 - Climatic conditions (temperatures and rainfalls) during the vegetation period of *Phaseolus vulgaris* and *Phaseolus coccineus* (2008)**

Temperatures/rainfall	May	June	July	August	September
Mean monthly temperatures (°C) 2008	13.7	18.3	19.2	20.0	13.0
Multiannual mean of rainfall (°C)	13.7	16.9	18.4	18.3	14.2
Sum of rainfall (mm) 2008	91.5	99.2	301.6	72.3	60.4
Multiannual mean of rainfall (mm)	80.2	93.6	88.6	62.8	40.8

Table 2 – Main morpho-physiological descriptors in the two analysed species of *Phaseolus*

Samples	No. of stem ramifications	Colour of leaves	Colour of inflorescence	Pod length (cm)	Pod width (cm)	No. pods/plant	No. beans/pod	Bean length (mm)	Bean width (mm)	Bean thickness (mm)	Colour of beans	1000-grain weight (g)	Plant vigour*	Frequency of the attack of <i>Xanthomonas campestris</i> (%)
<i>Phaseolus cocineus</i>														
SVGB-13625	3	Green	White	10.86	2.00	11	4	18.85	12.99	12.3	White	1104	9	10
SVGB-13630	2	Green	White	12.10	2.10	12	5	18.63	12.68	7.95	White	1056	9	1
SVGB-13648	2	Green	White	11.70	2.00	11	4	19.27	12.62	8.34	White	1234	9	1
SVGB-13671	2	Green	White	11.50	2.00	12	4	20.15	12.90	8.61	White	1348	9	1
SVGB-13718	3	Green	White	12.20	1.90	13	5	20.11	13.17	8.22	White	1375	9	10
SVGB-13720	3	Green	White	13.10	1.80	12	4	20.94	13.03	9.09	White	1245	9	1
SVGB-13725	3	Green	White	11.30	1.90	15	4	19.54	13.73	8.77	White	1258	9	0
SVGB-14186	4	Green	White	10.9	1.88	11	3	19.13	12.05	7.69	White	1141	9	1
SVGB-14188	3	Green with red ribs	Green with Red	12.2	1.79	11	4	19.52	13.05	8.67	Violet with black spots	1260	9	0

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<i>Phaseolus vulgaris</i>														
SVGB-13766	3	Green	White	13.6	1.28	12	7	13.21	8.75	6.51	Beige with brown spots	495	5	10
SVGB-14011	5	Green	White	12.90	1.25	10	6	13.06	8.94	6.28	Beige	506	5	25
SVGB-14057	6	Green	White	12.80	1.21	13	7	13.86	8.27	4.42	White	343	5	10
SVGB-14127	5	Green	White	8.80	0.8	10	6	11.76	7.36	5.93	Beige with brown stripes	373	5	10
SVGB-14150	6	Green	White	13.70	1.30	10	5	18.02	9.68	5.78	White	542	5	10
SVGB-14171	6	Green	White	12.30	1.49	10	7	13.29	8.20	6.69	Violet and white	495	5	1
SVGB-14172	4	Green	White	12.00	1.29	14	7	12.01	9.00	6.53	Dark red	514	5	10
SVGB-14175	4	Green	Violet roz	11.90	1.45	12	5	12.84	8.99	6.87	Beige with brown stripes	501	5	10
SVGB-14180	4	Green	White	13.10	1.40	10	7	12.74	8.46	6.83	Violet with white spots	382	5	1

\* FAO notation (1= very weak; 9= very vigorous)

**Table 3 – Phenological data concerning the two studied *Phaseolus* species (Suceava, 2008)**

Samples	Number of days from sowing to:				
	Raising	Appearance of the first trifoliolate leaf	Appearance of the first flower	Appearance of pods	Harvest
<b><i>Phaseolus coccineus</i></b>					
SVGB-13625	16	19	48	56	128
SVGB-13630	16	19	48	56	129
SVGB-13648	16	19	47	55	124
SVGB-13671	16	19	47	55	119
SVGB-13718	16	19	47	55	129
SVGB-13720	16	19	47	55	128
SVGB-13725	16	19	47	55	122
SVGB-14186	16	19	47	56	127
SVGB-14188	15	19	47	57	128
<b><i>Phaseolus vulgaris</i></b>					
SVGB-13766	18	24	67	77	113
SVGB-14011	16	23	67	77	113
SVGB-14057	17	24	67	77	114
SVGB-14127	17	24	69	78	115
SVGB-14150	17	24	67	77	113
SVGB-14171	18	24	69	79	115
SVGB-14172	17	24	67	77	111
SVGB-14175	16	23	65	75	112
SVGB-14180	17	25	69	79	115

The plants from *Phaseolus coccineus* species had a hypogeous growth and from *Phaseolus vulgaris* species, an epigeous emergence.

Table 2 shows the main morpho-physiological traits of the two species. The plants from *Phaseolus coccineus* species had a lower number of stem ramifications, but greater growth vigour, compared with plants belonging to *Phaseolus vulgaris* species. *Phaseolus coccineus* had 3-5 beans/pod; the number is lower than in the plants belonging to *Phaseolus vulgaris* species (5-7 beans). The sizes of *Phaseolus coccineus* seeds were much higher than of *Phaseolus vulgaris* seeds. In case of the

descriptor, the 1000-grain weight, we noticed that the values were two or three times higher in *Phaseolus coccineus* species, as compared with the values recorded in *Phaseolus vulgaris* species.

As concerns the resistance to biotic stress factors, we noticed that in 2008 prevailed the bean anthracnose, produced by *Xanthomonas campestris*. The samples studied in the field, which belong to *Phaseolus coccineus* species, were attacked by this pathogen at a lower rate (0-10%); in exchange, the samples from *Phaseolus vulgaris* species were attacked at a greater rate (10-25%).

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At harvest, we noticed the high rate of other colour seeds, compared to the colour of the original sample in *Phaseolus coccineus* species, which showed a high degree of allogamy. In exchange, the seeds belonging to *Phaseolus vulgaris* species had the same colour as the original sample.

As concerns the phenological observations, we noticed that under conditions of year 2008, in the experimental field of the Gene Bank of Suceava, the first trifoliate leaf appeared 3-4 days earlier in *Phaseolus coccineus* than in *Phaseolus vulgaris* samples, and the first flowers and pods appeared 20-22 days earlier in *Phaseolus coccineus*. In exchange, the plants of *Phaseolus vulgaris* reached maturity 8-15 days earlier. If in the first phenological phases, the differences between the two species were of 1-3 days, during the vegetation period these differences became greater, reaching 15 days, under the climatic conditions of year 2008, in the experimental field of the Gene Bank of Suceava (Table 3).

### CONCLUSIONS

The two studied species of *Phaseolus* have distinctive morphological characteristics, showing great differences as concerns the 1000-grain weight (g) and the pod and bean sizes.

The plants belonging to *Phaseolus vulgaris* species had a lower vigour and were more susceptible to the attack produced by *Xanthomonas campestris*, compared

to *Phaseolus coccineus* species, which showed a high vigour and a greater resistance to the attack of the pathogen.

Under conditions of year 2008, in the experimental field of the Gene Bank of Suceava, samples belonging to *Phaseolus coccineus* species raised, flowered and fructified 2-20 days earlier than samples from *Phaseolus vulgaris* species.

Although *Phaseolus coccineus* behaved as an early species, samples sown in 2008, in the experimental field have reached maturity 8-15 days later than samples belonging to *Phaseolus vulgaris* species. This might be caused by the high rainfall and low temperatures recorded in September 2008.

The differences found between the two species correspond to data shown in the literature.

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