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PRELIMINARY RESULTS ON THE BEHAVIOUR OF SOME GARDEN PEA ACCESSIONS BRED AT VEGETABLE RESEARCH DEVELOPMENT STATION BUZAU, ROMANIA

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Abstract

Pisum sativum belongs to Fabaceae family and is especially appreciated for its nutritional qualities. According to FAO statistics from 2019, in the world green peas are cultivated on relatively large areas. The highest yield of world production was obtained in Asia followed by Europe and USA with lower percentage. In Romania, only 2430 ha of garden peas are cultivated and the assortment of cultivars is quite limited. At VRDS Buzău, a breeding program has started and currently 15 stable accessions are being studied. This study presents preliminary results on the behaviour of improved accession. According to UPOV descriptors, it was observed that the accessions show distinct phenotypic expressiveness, with types of flowers varying from white to pink, with pods having a length ranging from 6.43 to 13.4 cm and weight of 10 pods differs from 41.8 to 84.8 g. The coefficient of variations exceeds 35%, which indicates that there is a large variability among studied accessions. The study will continue with selection work of genotypes that have distinct results and high ecological plasticity.

Key words*: genotype, improved, phenotype, Pisum sativum, selection.*

INTRODUCTION

According to FAO studies and statistics, peas have long been recognised as an inexpensive, readily available source of protein, complex carbohydrates, vitamins and minerals.

The high nutrient density of peas makes them a valuable food commodity, capable of meeting the dietary needs of the estimated 800-900 million undernourished individuals worldwide (FAO Statistics, 2011).

Based on the studies performed, it can be appreciated that the importance of legumes is due, first of all, to the high protein content of the seeds giving a significant nutritional value. The protein content of legumes exceeds 2-3 times more than cereals (Samuil, 2007).

In the context of current concerns about the future of human nutrition the protein content is an important issue. Proteins are basic, essential components of food rations so that any deficiency of these substances can lead to more or less severe food deficiencies (Mincu, 1978).

Many studies have identified potential health benefits of peas, as mentioned: cardiovascular health (Sandström et al., 1994; Trinidad et al., 2010), gastrointestinal health (Dahl et al., 2003; Flogan and Dahl, 2010) antioxidant activity (Dueňas et al., 2004), high content in complex carbohydrate (Hoover et al, 2010; Tosh and Yada, 2010) and glycaemic response and insulin resistance (Marinangeli et al., 2009).

From an agronomic point of view, peas are valuable for: helps to enriches the soil with nitrogen, having the ability to fix molecular nitrogen in the atmosphere, through nodules resulting from symbiosis with *Rhizobium* sp. bacteria, thus contributing to improving soil fertility (Popescu and Roman, 2008).

Also, the pea root system has the capacity to solubilize phosphorus compounds, making this element available to the successor plant in a more accessible form.

The pea root system is well developed in depth, ensuring a good stability of the soil.

The beneficial intake of pea root in land is based on the improvement of nitrogen, one of the key factors for ensuring soil fertility, supporting the production of cereals in dry or developing areas (Jacobsen et al., 2012).
World production of peas in 2019 (according to FAOSTAT) was more than 19 million tonnes, with a harvested area of over 2 million ha. The major producers being in Asia (China, India) with a percentage of 85.1%, in Europe with just 8.7% and USA with 6.2%. In Romania, according to the same statistics, green peas occupy just 2430 ha, with a yield of 5589 t, but the assortment of cultivars is quite limited.
Currently, in the Official Romanian Crop Plant Catalogue, has a number of 9 cultivars of garden peas. Because of the low number of valuable cultivars, at Vegetable Research Station (VRDS) Buzau has started a breeding program (Barcanu et al., 2019). In this work, 15 accessions of *Pisum sativum* have been evaluated from the agro-morphological point of view, in order to establish the important traits of the studied accessions.

MATERIALS AND METHODS

The germplasm pea collection from Breeding and Biodiversity Laboratory of VRDS Buzau had as main sources of genetic material: local landrace; cultivars collected from the main vegetable basins in Romania; cultivars and hybrids from Romania and abroad. VRDS Buzau has a valuable germplasm collection of *Pisum sativum* and in the present study were selected 15 stable accessions.
The experiments were carried out at VRDS Buzau in the research field. The sowing was made in the first decade of March. The Research Centre is located in the Buzău riverside and has sandy-loam soil.
The area is characterized by a dry climate, with hot summers, with temperatures exceeding an average of 22°C in the warmest month and with a low rainfall distributed unevenly throughout the year. The annual average rainfall being 538 mm. The maximum temperature, minimum temperature and rainfalls in the studied years are shown in Table 1.

Table 1. Mean of temperature and rainfall during studied years (°C, mm)

2019	**March**	**April**	**May**	**June**	**July**
Temp. max	15.93	16.5	22.51	29.3	29.35
Temp. min	2.74	5.43	11.74	17.9	16.87
Rainfall	48.1	39.4	221.6	33.2	64
2020	**March**	**April**	**May**	**June**	**July**
Temp. max	14.35	19.93	22.77	28.3	30.77
Temp. min	3.32	4.8	10.7	16.16	18.09
Rainfall	29.3	6.9	102.5	78.1	75

The morphological characteristics are divided in two groups: qualitative and quantitative traits according to UPOV guidelines.
The qualitative traits used in this study are presented in Table 2.

Table 2. Qualitative traits

Plant: anthocyanin coloration AC	1. absent, 9. present.
Foliage: colour FC	1. yellow green, 2. green, 3. blue green.
Leaf: leaflets F	1. absent, 9, present.
Flower: colour of wing CW	1. white with pink blush, 2. pink, 3. reddish purple.
Flower: shape of base of standard BS	1. strongly raised, 3. moderately raised, 5. level, 7. moderately arched, 9. strongly arched.
Pod: shape of distal part SP	1. pointed, 2. blunt.
Pod: curvature C	1 absent or very weak. 3 weak. 5. medium 7 strong. 9 very strong.
Pod: colour PC	1. yellow, 2. green, 3. blue green, 4. purple.
Intensity of green colour IGC	3. light, 5. medium, 7. dark.
Pod: suture PS	1. absent, 2. present.
Immature seed: intensity of green colour GC	3. light, 5. medium, 7. dark.
Seed: shape S	1. ellipsoid, 2. cylindrical, 3. rhomboid, 4. irregular.
Seed: type of starch grains SG	1. simple, 2. compound
Seed: intensity of wrinkling of cotyledon IC	3. weak, 5. medium, 7. strong, 9. very strong.
Seed: colour of cotyledon CC	1. green, 2. yellow, 3. orange.
Seed: hilum colour HC	1. same colour as test, 2. darker than testa

Quantitative traits used were: plant length (PL), stem length (SL), number of nodes including first fertile node (NN), number maxim leaflet (NML), leaflet length (LL), leaflet width (LW), stipule length (SL), stipule width (SW), Stipule length from axil to tip (ST), petiole length measure from axil to first leaflet or tendril (PLA), flower width (FW), width of upper sepal (WS), length of spur (LS), length from stem to first pod (LFP), length between first and second pods (LSP), pod length (PL), pod width (PW). The production characters used were: number of ovules per pod (PNO), number of pods/m^2(NP), number of pods per plant (NPP), weight of 10 pods (WP), weight of 10 seeds (W), diameter seeds (D), total soluble content (°Brix).

RESULTS AND DISCUSSIONS

The studied accessions were described using UPOV guidelines. During vegetation period qualitative traits were noted and their distribution are found in Table 3. The qualitative traits were statistically distributed using histograms, and it was noted that 12 accessions did not have anthocyanin coloration, while 3 accession (A6, A7, A9) had. The colour of the foliage varied from green-yellow on accession (A8), to green to 3 accessions (A5, A7, A9) and green-blue to 11 accessions.

Figure 1. Type of flowers on studied accessions

The wing color of the anthocyanin-colored varieties was pink on one accession (A7) and red-purple on two accession (A6) (Figure 1). The standard colour of the flower in the varieties without anthocyanin coloration was white in all studied accessions (Figure 1). The shape of distal part of the pod was pointed at 80% of the accessions, and blunt at accessions A7, L8 and A11.

The curvature pod was absent or very weak in 40% of the accessions and weak in 8 accession, and medium in one accession, A8. The colour of the pod varied from green (A1, A6, A8, A9, A10), to green-blue (A2, A3, A4, A5, A11, A13, A15), to yellow (A12) and purple (A7).

Table 3. Qualitative traits

Traits	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
AC	1	1	1	1	1	9	9	1	9	1	1	1	1	1	1
FC	3	3	3	3	2	3	2	1	2	3	3	3	3	3	3
F	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CW	1	1	1	1	1	3	3	1	1	1	1	1	1	1	1
BS	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1
SP	1	1	1	1	1	1	2	1	2	1	1	2	1	1	1
C	3	3	1	1	3	1	1	5	3	3	1	3	3	3	1
PC	2	3	3	3	3	2	3	2	2	2	2	1	3	2	3
IGC	3	3	3	5	3	5	5	3	5	5	3	3	5	7	3
PS	9	1	9	9	9	1	1	9	9	1	1	1	1	1	1
GC	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5
S	1	2	1	1	2	1	2	2	2	2	2	2	2	2	2
SG	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1
IC	1	2	1	1	2	1	2	2	2	2	2	2	2	2	2
CC	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
HC	1	1	2	1	2	1	1	2	2	1	1	2	2	1	1

The intensity of the green colour also varied from light to 53.3% of accessions, to medium for 30% of accessions and dark for accession A14. In Figure 2 are presented the type of pods studied.

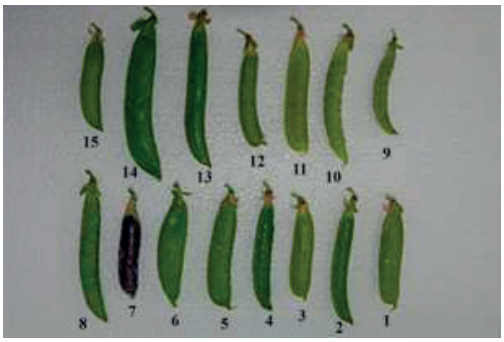

Figure 2. Phenotypic expression of pea pods

The pod suture was present for 6 accessions and absent for accessions: A2, A6, A7, A10, A11, A12, A13, A14 and A15. The grain shape of was ellipsoidal for 26.7% of accessions and cylindrical for the rest of 73.3%. The type of starch grain was simple for 7 accessions and compound for 8 accession. The intensity of wrinkling of cotyledon seed was weak for all the studied accessions. The colour of cotyledons was green for 13 accessions and yellow for 2 accessions (A8, A9). The hilum colour was the same for 10 accessions and darker than the skin for the remaining 5 accessions (A3, A5, A8, A12, A13). In Figure 3 are presented the crop detail and a pod grain aspect.

Figure 3. Crop details and pod development

The quantitative traits were measured and the mean results were noted in Tables 4 and 5. The coefficient of variation had a wide variability especially in terms of stem length, number of pods/m^2 and weight of 10 pods.

The plant height had varied from 27.36 cm to (A1) to 75.55 cm (A6). According to standards, cultivars are considered dwarf or semi-tall with a height between 30-70 cm, and tall, with a height over 100 cm (Drăghici, 2015). The number of nodes including first fertile node had variations from 15.5 to A7 to just 6.5 nodes at A5. The pea leaf has a pair of basal stipules and a rachis supporting opposite pairs of leaflet. Leaflets and tendrils occupy predictable positions on the rachis (Gould, 1986); tendrils are normally formed distal to leaflets. The leaflet length on studied accessions varied from 2.46 cm on A10 to 4.45 cm to A14. Leaflet width had some variations between the same accessions, from 3.2 cm to A10 and 1.55 cm to A14. Stipule length was diverse from 4.65 (A10) to 7.07 cm (A14). The pea flower is self-fertile.

The pea pod is dehiscent, but in "edible podded" (mange-tout) accessions, like A6, the pods have little or no parchment. The largest variations within studied accessions were in terms of size pods. The lowest value was recorded by A7with just 6.44 cm number and the maximum value was noted at A6 with 13.53 cm. The number of pods/m^2 is accession dependent, in this case, A3 and A4 had a number of pod varied from 556 to 597 and at the opposite pole, A8 had recorded a number of 98 pods/m^2. In terms of pods weight, the mass of 10 pods fitted between 84.85 g (A14) to 44.85 g (A4). Regarding the weight of 10 seeds, A6 had registered 15.39 g and A3 just 3.2 g.

The mean yield/m^2 was graphically represented in figure 4. It can be noted that the highest yield potential was recorded by A3 and A4 (over 2 kg/m^2), and the lowest yield were obtained by the A7 and A8 (below 900 g/m^2).

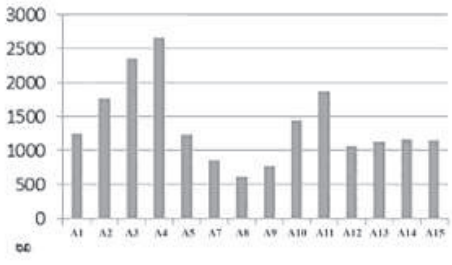

Figure 4. Yield per plant on studied accessions (grams)

Table 4. Quantitative traits the plant

Accession	(PL)	(SL)	(NN)	(NML)	(LL)	(LW)	(SL)	(SW)	(ST)	(PLA)	(FW)	(WS)
A1	27.37	3.73	6.83	6	3.96	1.82	5.33	2.86	3.86	2.36	0.85	2.06
A2	50.32	3.35	8.5	3.5	3.96	2.42	6.66	3.35	5.13	2.77	0.86	2.05
A3	49.12	3.76	9.17	5	2.85	1.75	6.04	3.34	4.51	4.02	0.75	2.35
A4	64.43	6.26	12.67	4.5	3.74	1.65	6.75	4.97	4.74	4.42	1.06	2.13
A5	52.3	3.25	6.5	5	3.33	2.37	5.84	2.8	4.42	2.67	0.78	1.96
A6	75.55	2.06	8	5	3.23	2.44	6.55	3.46	4.85	3.2	0.52	2.23
A7	38.75	3.68	15.5	5	2.94	1.84	5.74	5.4	3.89	5.2	0.66	1.34
A8	57.08	1.76	14.5	4	3.25	1.79	5.72	4.71	4.15	4.07	0.98	2.53
A9	30.34	1.2	12.67	5	3.07	1.88	5.06	4.82	3.83	3.72	0.98	2.56
A10	44.5	2.26	7	4.88	2.47	1.56	4.65	2.25	3.54	2.9	0.85	2.65
A11	50.94	2.3	7	5	3.8	2.22	4.75	2.46	3.93	3.72	0.92	1.96
A12	55.17	5.44	9	6	3.77	1.85	5.1	2.45	4.25	4.4	0.45	2.45
A13	45.77	2.36	8	4	4.2	2.3	5.78	2.65	4.65	4.45	0.85	2.25
A14	65.7	1.6	8	6	4.45	3.2	7.08	4.5	6.44	6.04	1.03	2.55
A15	56.3	2.4	7	4	4.2	2.25	5.92	2.65	4.5	4.45	0.85	2.3
Means	50.9	3	9.4	4.9	3.5	2.1	5.8	3.5	4.4	3.9	0.8	2.2
SD	12.36	1.36	2.87	0.74	0.56	0.41	0.71	1.04	0.68	0.97	0.17	0.32
CV%	24.28	44.92	30.7	15.23	15.68	19.75	12.28	29.53	15.33	24.94	20.22	14.48

Table 5. Quantitative traits the pods

Accession	(LS)	(LFP)	(LSP)	(PL)	(PW)	(PNO)	(NP)	(NPP)	(WP)	(W)	(D)	(G)
A1	0.71	18.82	3.96	8.49	1.01	7.37	238	4.53	53.22	2.48	8	54.5
A2	0.86	28.66	2.85	11.45	0.93	6.5	326	10.82	54.53	3.37	5.83	61
A3	0.46	27.75	3.05	7.12	0.8	5.75	556	14.5	42.46	3.2	5.71	76
A4	0.72	21.25	4.07	8.15	1.05	8.13	597	11.2	44.86	2.66	5.07	64.5
A5	1.09	19.84	2.84	7.64	0.97	6.65	250	4.83	49.65	2.94	5.07	85.5
A6	2.77	33.32	3.86	13.53	0.36	6.13	114	4	47.69	15.39	7.78	51
A7	0.86	31.75	3.7	6.44	2.2	9	171	7.7	50.75	5.09	6.29	66
A8	0.73	17.78	3.13	7.82	1.27	5	99	8	63.27	3.94	8.55	84
A9	0.75	23.3	5.74	7.45	1.15	8	137	8.8	56.96	4.57	5.94	67
A10	0.82	20.16	4.15	8.84	1.25	7.4	253	7	56.96	4.57	9.81	64.5
A11	0.66	25.52	3.54	9.15	0.94	4.45	376	8.17	50.04	4.2	10.13	94.5
A12	0.85	28.65	2.85	7.6	0.85	6	234	10	45.62	4.67	5.56	76
A13	1.05	26.85	2.85	9.66	0.65	8	175	8	65.11	2.87	7.97	68.5
A14	1.55	40.65	6.4	12.45	0.85	7.7	137	6	84.85	5.6	9.2	69
A15	0.8	28.55	4.85	8.84	1.1	3.68	280	8	41.19	4.54	7.55	76
Means	1	26.2	3.9	9	1	6.6	262.7	8.1	53.8	4.7	7.2	70.5
SD	0.54	6.03	1.05	1.96	0.39	1.45	144.6	2.68	10.69	3.01	1.66	11.29
CV%	54.76	23.04	27.21	21.84	37.61	21.77	55.05	33.12	19.87	64.4	22.91	16

CONCLUSIONS

The result of the study showed that there is great variability within the studied genotypes. The A7 was the only accession with purple flower and pods and A6 had light purple flowers and green pods.

These accessions could also be used as decorative plants due to the pleasant appearance of the flowers.

Following the assessment of accessions, it was highlighted that A3 and A4 had the highest yield. A6 is recommended as mange-tout peas. The research will continue through more detailed study.

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