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Bean and cowpea landraces - interspecies differences in drought tolerance, agrobiological characteristics and seed chemical composition

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Introduction

Legumes are a complete food rich in proteins and carbohydrates. Bean (*Phaseolus vulgaris* L) is widespread in our country, but it is sensitive to adverse environmental conditions such as high temperatures and drought. Cowpea (*Vigna ungviculata* L. Walp.) has a more limited distribution mainly in the southern regions, but it is characterized by high stress resistance and would be a good alternative of bean crops in view of the coming climate changes. The aim of this study was to compare local bean and cowpea landraces in terms of field performance, yield and seed chemical composition.

Results and discussion

In a laboratory experiment, the response of cowpea and bean to moderate osmotic stress at seedling stage was compared, using established varieties of bean ("Blian", selection of Dobrudja Agricultural Institute (DAI), and cowpea ("Hrisi", selection of Institute of Plant Genetic Resources (IPGR). Germinated seeds were sown in perlite and grown in half strength Hoagland nutrient solution in controlled conditions (16/8h photoperiod, light intensity 150 µmol.m^{-2}s^{-1}, 24^{o}C and 60% air humidity). Osmotic stress of intensity -0.6 MPa (by adding polyethylene glycol - PEG 6000 in the nutrient solution) was applied on plants with fully developed first trifoliate leaf and expanding second one, for a period of two to four weeks.

Cowpea–left treated, right controls 14 days stress

species	Days stress	Controls			Treated PEG 6000		
		WD %	FW per plant (g)	Root/ Shoot	WD %	FW per plant (g)	Root/ Shoot
cowpea	14	5,46	6,06	0,749	12,24	3,54	0,628
cowpea	28	7,34	8,35	0,920	27,12	3,12	0,773
bean	14	8,73	9,19	0,623	30,16	5,78	1,079
bean	28	5,42	12,53	0,374	29,57	4,38	0,717

WD-leaf water deficit, FW – fresh weight

Bean–left treated, right controls

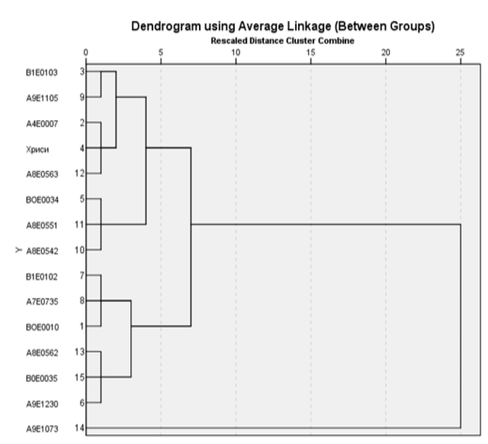
Local forms of bean and cowpea, collected and stored at the Institute of Plant Genetic Resources – Sadovo, were characterized agro biologically in field trials during 2021 at the experimental field of IPGR.

The collected seeds were analyzed for energy value, content of proteins, fats, carbohydrates, fibers, ash, tannins.

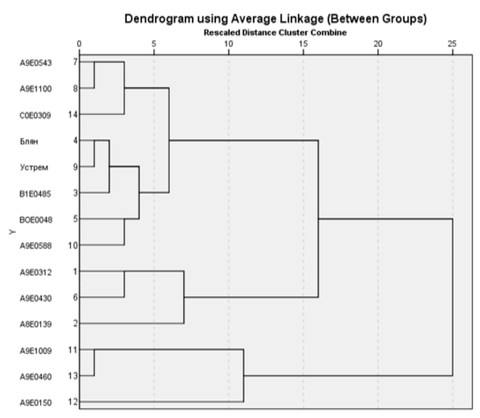
Cowpea local landraces and yield per plot

№	Cat.№	origin	yield (g)	Significan-ce of the difference
1	BOE0010	Pasardjik	408,6	abc
2	A9E1105	Kap. Andreevo	434,0	abc
3	A9E1230	Smolian	294,9	a
4	B1E0102	Petrich	441,9	abcd
5	B1E0103	Pasardjik	415,8	abc
6	A7E0735	Kavarna	415,2	abc
7	A9E0542	Kap. Andreevo	670,6	d
8	BOE0034	Haskovo	610,6	cd
9	var. Hrisi	IPGR-Sadovo	487,5	abcd
10	A4E0007	Svilengrad	539,8	bcd
11	A8E0551	Yerusalimovo	603,0	cd
12	A8E0563	Kap. Andreevo	553,0	bcd
13	A8E0562	Kap. Andreevo	292,1	a
14	A9E1073	Haskovo	888,5	e
15	BOE0035	Haskovo	362,6	ab

Cluster analysis cowpea



Cluster analysis bean



cowpea bean

Bean local landraces and yield per plot (5,6 m^2)

№	Cat.№	origin	yield (g)	Significan-ce of the difference
1	A9E0312	Silistra	412,3	fg
2	var. Ustrem	DAI Gen. Toshevo	288,7	bcdef
3	A9E0430	Obretenik, Russe	375,5	efg
4	A9E0543	Totleben, Pleven	266,5	bcde
5	B1E0485	Velingrad	321,2	def
6	A9E1100	Bisser,near Haskovo	278,9	bcdef
7	A9E0588	Umarevtsi, Lovetch	227,8	bcd
8	BOE0048	Dimitrovgrad	265,6	bcde
9	var. Blian	DAI Gen. Toshevo	271,8	bcdef
10	A8E0139	Klisura, near Sofia	485,1	g
11	A9E0150	Sevlievo	89,4	a
12	C0E0309	Sadovo	315,0	cdef
13	A9E0460	Oriahovitsa, Pleven	164,9	ab
14	A9E1009	Dragoshinovo,Sofia	174,1	abc

The results on chemical composition and energy value of seed samples have shown both variability of local legume forms and equivalence of the two crops as complete foods.

№	cat №	humi-dity %	prote-in %	fat %	asch %	fiber %	tanin %	carbo hydr %	kcal/ 100g
1	BOE0010	10,9	27,0	1,6	4,1	4,4	16,4	56,5	348,2
2	A4E0007	12,0	24,7	2,6	4,3	3,6	20,0	56,5	347,6
3	B1E0103	11,4	25,7	2,3	4,0	3,5	18,8	56,7	350,1
4	"Hrisi"	11,7	24,4	2,3	4,1	3,6	19,1	57,6	348,1
5	BOE0034	11,8	24,2	2,4	4,3	4,0	19,7	57,4	347,8
6	A9E1230	11,5	22,4	2,1	3,9	4,4	20,4	33,1	348,9
7	B1E0102	11,5	25,3	2,1	4,1	3,1	17,5	57,0	347,9
8	A7E0735	11,6	25,6	1,9	3,9	4,3	20,7	57,2	347,5
9	A9E1105	11,6	24,9	2,1	4,0	3,2	19,5	57,5	347,7
10	A8E0542	10,2	22,5	1,9	4,1	4,5	17,9	61,4	352,8
11	A8E0551	11,7	24,8	2,2	3,9	4,3	21,0	57,8	347,6
12	A8E0563	11,8	25,1	1,9	3,9	3,6	19,3	57,2	348,2
13	A8E0562	11,8	25,4	1,9	3,8	3,3	20,2	57,3	347,1
14	A9E1073	12,0	23,9	1,7	4,0	4,0	22,1	58,4	344,1
15	B0E0035	11,7	22,5	1,5	4,3	4,3	19,2	60,6	345,5

№	cat №	humi-dity %	prote-in %	fat %	asch %	fiber %	tanin %	carbo hydr %	kcal/ 100g
1	A9E0312	11,0	25,6	2,2	5,1	5,4	16,0	56,3	346,9
2	A8E0139	12,2	21,8	1,7	4,7	5,3	18,4	59,7	341,1
3	B1E0485	12,2	23,4	1,9	5,1	5,7	16,5	57,6	340,3
4	"Blian"	11,8	22,2	1,7	4,6	5,7	13,6	59,9	343,3
5	BOE0048	11,6	24,5	2,2	5,1	5,6	20,2	56,7	344,2
6	A9E0430	11,9	22,7	2,5	4,8	3,3	19,1	58,2	345,9
7	A9E0543	11,9	23,5	2,1	4,6	4,8	18,0	58,1	344,5
8	A9E1100	11,9	24,2	2,2	4,6	4,8	21,5	57,2	345,2
9	"Ustrem"	12,1	23,4	2,4	4,8	5,3	17,4	57,4	344,6
10	A9E0588	12,2	25,4	2,5	4,7	4,7	17,1	55,3	344,9
11	A9E0150	11,6	26,6	1,7	5,4	3,3	16,6	54,4	338,9
12	C0E0309	11,7	22,2	1,9	4,7	3,6	14,0	59,6	344,6
13	A9E0460	11,7	27,0	1,9	5,3	3,9	21,3	54,2	341,9
14	A9E1009	11,9	23,0	1,6	4,7	5,9	19,8	58,9	341,4

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