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AGRONOMICAL CHARACTERISTICS THE BREEDING GERMPLASM OF CHICKPEA

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Abstract. *Investigation material comprised twenty(F5) and eight ten (F3) breeding germplasm of chickpea derived from 2 crosses ♀Alexandrite×♂Ichel and ♀Botna×♂Ichel respectively, as check was v. Botna. The objective of the study was evaluation and selection germplasm by yield and analysis 5 yield attributing characters: number seeds and seeds yield per plant, hundred seeds weight, plant height and full maturity. Method of breeding is "pedigree". By productivity were selected 10(F4) and 12(F5) progenies, of them B121, B144, B126, B130, B137, B143, B147 and A170, A181, A190 were evaluated as high yielded (116.1 – 124.2g/m^2), which superior the check v. Botna (106.5g/m^2). Analysis of traits revealed that no. of seeds and seeds yield per plant are principal in yield enhancing. Larger seeds germplasm coupled with taller plant for most progenies increases yield per plant. Most high yielded germplasm is middle-maturity. Strong relationship exhibited trait seeds yield per plant with plant height (r=0.855), hundred seeds weight (r=0.881) and with no. seeds per plant (r=0.891) in F4 and F6 generation, respectively.*

Keywords: chickpea germplasm, F4, F6-generation, yield attributing traits, yield.

INTRODUCTION

Despite recent growth in chickpea production, challenges like climate change, emerging diseases and market issues remain significant. To overcome these issues through crop improvement, genetic variability and diversity studies are the fundamental requirement [1]. India is the leading country of chickpea gross production. Shreyasee Seth *et al*. (2020) reported about yield varieties in India: Uday- 1058 kg/ha, JG 14- 908 kg/ha, Anuradha - 904 kg/ha, Vaibhav -787 kg/ha) [2]. Romanian researchers Pânzaru Radu Lucian *et al.* (2022) in their work reported: the culture presents a productive potential for Romania, between 1000 and 1500 kg/ha, under the conditions of use, in production, of local populations and varieties [3]. About yield attributing traits Moulya G. et al. (2024) related: correlation studies revealed that, seed yield was in positive association with number of pods per plant, plant height and hundred seed weight [1]. In Ethiopia Doda Gemeda A. and Nepir Gurmu G. (2024) in his research concluded that seed yield in chickpea can be improved by selecting the plant that have greater number of pods per plant and number of seeds per plant [4]. In aspect yield per area Sweta Soni *et*

al. (2024) communicate: that plot yield in grams had significant and positive correlation with hundred seed weight, harvest index and seed yield per plant [5]. In R. Moldova released for cultivation 4 varieties: Botna, Ichel, Cogâlnic and Ovidel [6]. Alexandrite is Ukrainian variety. In this work presented results of evaluation breeding germplasm F4 and F6 for yield and main yield attributing characters.

MATERIALS AND METHODS

Method of breeding the germplasm is "pedigree"[7]. Eight ten (F3) and twenty (F5) breeding germplasm of chickpea derived from 2 crosses Botna ×Ichel and Alexandrite× Ichel, respectively were evaluated on yield and 5 yield attributing characters: seeds and seeds yield per plant, hundred seeds weight, plant height and full maturity of plants. The field experiment was carried out in 2024. Material laid out random in 2 replications, rows 3.0 m length, inter row distance 50 cm and plant to plant -10cm. As check was used cv. Botna. The sowing was 3-4 April. Seven plant from each entry were randomly collected for data seeds & seeds yield per plant. Plant height were measured before plant maturing. Selection criterion based on productivity at the check level and higher. Observation of maturity: first date 50%, second one 100% plants were full maturity. Seeds data (type, color and HSW) described according to the descriptors for chickpea.

RESULTS AND DISCUSSIONS

By productivity in the F4 generation were selected 10 progenies, namely: B121, B123, B126, B130, B137, B143, B144, B147, B150 and B152. Type of seeds these genotypes are: *desi* only genotype B152 as well as check v. Botna. Genotypes B121, B126 and B137 had segregation into *desi* and *gulabi*, others - *kabuli* (genotypes B143 and B144 had a little amount *gulabi/desi* and intermediate d*esi-gulabi* type). By seed color genotypes B126 and B 152 as well as v. Botna are brown. Genotypes B121, B137, B143 and B144 had segregation into brown and green, B123, B130, B147 and B150 – beige (Table1).

In F6 generation by yield were selected 12 germplasm: A157, A170, A171, A173, A181, A184, A186, A192, A201and A202 by type seeds are kabuli, A204 – gulabi and A191- intermediate gulabi-kabuli. Color of seeds: A157 and A190 – light-brown, A201 and A202 – beige, A192 – Brown-green, A204 – orange-yellow others are brown (Table2).

Table 1. Type and seeds' color of germplasm, F4 generation (Botna ×Ichel)

Name of progenies	Type of seeds	Color of seeds	Name progenies	Type of seeds	Color of seeds
v. Botna	Desi	Brown	B143	Kabuli*	Brown/green
B121	Desi/Gulabi	Brown/green	B144	Kabuli**	Brown/green
B123	Kabuli	Beige	B147	Kabuli	Beige
B126	Desi/Gulabi	Brown	B150	Kabuli	Beige
B130	Kabuli	Beige	B152	Desi	Brown
B137	Desi/Gulabi	Brown/green	-	-	-

**g/d and **d-g / little amount of seeds*

Five yield attributing characters were measured /observed in selected germplasm: seeds and seeds yield per plant, hundred seed weight, plant height, time of full maturity. As resulting character - seed yield/m^2. The range four of them in descending order for F4/F6 constituted following values: plant height (11.5/13.3), hundred seed weight (6.1/2.8), seeds per plant (4.64/4.36) and seed yield per plant (2.0/1.7).

Table 2. Type and seeds' color germplasm, F6-generation (Alexandrite ×Ichel)

Name of progenies	Type of seeds	Color of seeds	Name progenies	Type of seeds	Color of seeds
A157	Kabuli	Light-brown	A186	Kabuli	Brown
A170	Kabuli	Brown	A190	G-k	Light-brown
A171	Kabuli	Brown	A192	Kabuli	Brown-green
A173	Kabuli	Brown	A201	Kabuli	Beige
A181	Kabuli	Brown	A202	Kabuli	Beige
A184	Kabuli	Brown	A204	Gulabi	Orange-yellow

Thus, PH had maximum range for both generation, in regard HSW in F4 generation was greater than in F6 one, range of seeds and seed yield per plant are commensurate between generation. Difference between mean values at F4 and F6 also in descending order are: plant height (6.43cm, 50.44/ 56.87), HSW (2.59g, 26.43/ 29.02), mean seeds per plant at F4 (30.71) a little greater than at F6(28.24) and seeds yield per plant (8.12/8.2) without significant difference. Range of yield per m^2 in F4 generation was 104.3g – 122.5g, in F5 one 105.4g – 124.2g(commensurate) but mean values in F4 -114.54g a little greater than F6-110.86g. (Table3,4).

Full maturity of v. Botna was observed 18 July, at F4 generation closely by this character were by genotypes B126, B150 and B152 – 18-19 July. Genotypes B123, B130, B137, B143 and B144 full maturity observed on19-20 July, little later genotypes B121 and B147 (20-21 July). Thus, full maturity was at 1-2 days later (except B121, B147) than v. Botna (Table3).

Table 3. Yield and yield attributing characters, F4-generation (v. Botna × v. Ichel)

Progenies	Seeds/Pl	SY/Pl	100-SW	Plant Height	Maturity	SY/m^2
v. Botna	27.86±1.13	7.56	27.1 ±0.22	45.7±0.37	18/07	105.7
B121	31.76±1.14	8.67	27.3±0.45	51.3±0.51	20-21.07	122.5
B123	30.5 ±1.22	7.15	23.4±0.35	49.8±0.46	19-20.07	104.3
B126	31.1±1.15	9.05	29.1±0.43	55.4±0.49	18-19.07	119.4
B130	32.0±1.25	9.15	28.6±0.36	57.2±0.53	19-20.07	120.8
B137	30.5±1.17	9.0	29.5±0.42	52.5±0.48	19-20.07	120.1
B143	31.6 ±0.98	7.7	24.5±0.47	48.1±0.52	19-20.07	117.5
B144	32.5±1.27	8.22	25.3±0.45	50.7±0.51	19-20.07	121.3
B147	30.71±1.18	7.96	25.9±0.29	48.3±0.47	20-21.07	116.1
B150	29.88±1.16	7.44	24.9±0.27	47.8±0.46	18-19.07	106.4
B152	29.44±1.12	7.42	25.2±0.26	48.1±0.48	18-19.07	105.9
Min	27.86	7.15	23.4	45.7	18-19.07	104.3
Max/range	32.5/ 4.64	9.15/2	29.5/ 6.1	57.2/ 11.5	20-21.07	122.5
Mean	30.71	8.12	26.43	50.44	-	114.54
CV,%	4.3	9.0	7.57	6.88	-	6.4

Maturity at F6 generation: germplasm as A190, A202 and A204 full maturity observed 19 July, 6 germplasm, namely: A170, A171, A181, A186, A192 and A201 had the latest maturation 22-23 July, intermediate were A157, A173 and A184 – 20-21 July. Range of maturity at F6 generation was 5 days (19-23.07) 2 days greater compared to F4 one, 3 days (19-21.07). So, ripening germplasm of F6 generation had somewhat later than F4 one (Table 4).

Table 4. Yield and yield attributing traits F6-generation (v. Alexandrite ×v. Ichel)

Progenies	Seeds/Pl	SY/Pl	100-SW	Height Plant	Maturity	SY/m^2
v. Botna	27.9±1.15	7.62	27.3 ±0.22	46.9±0.37	18.07	107.3
A157	27.6±1.18	7.81	28.3±0.29	56.7±0.47	19-20.07	106.5
A170	30.93±1.22	9.28	30.0±0.32	59.6±0.49	22-23.07	124.2
A171	27.74±1.21	8.1	29.2±0.31	59.1±0.48	22-23.07	108.4
A173	26.87±0.98	7.95	29.6±0.28	57.3±0.42	20-21.07	107.1
A181	30.53±1.24	9.19	30.1±0.32	60.2±0.50	22-23.07	121.8
A184	27.86±1.19	8.22	29.5±0.27	55.9±0.45	19-20.07	109.2
A186	27.5±1.13	8.17	29.7±0.29	57.6±0.48	22-23.07	108.6
A190	29.76±1.23	8.78	29.5±0.30	56.7±0.44	19.07	120.3
A192	27.54±1.17	7.85	28.5±0.33	58.4±0.47	22-23.07	106.7
A201	26.57±1.09	7.89	29.7±0.29	59.5±0.52	22-23.07	105.4
A202	28.26±1.14	7.8	27.6±0.26	55.3±0.46	19.07	107.5
A204	28.06±1.09	7.94	28.3±0.25	56.2±0.47	19.07	108.2
Min	26.57	7.62	27.3	46.9	18.07	105.4
Max/range	30.93/ 4.36	9.28/1.7	30.1/ 2.8	60.2/ 13.3	22-23.07	124.2
Mean	28.24	8.2	29.02	56.87	-	110.86
CV, %	4.71	6.58	3.17	5.92	-	5.9

Coefficient of correlation: Plant height exhibited significant positive relationship with HSW in both generation F4(r=0.656), F6(r=0.746). PH with no. seeds per plant showed significant value only in F4(r=0.614), with seeds yield per plant were observed strong association in F4(r=0.855) and moderate one in F6(r=0.506). Hundred seeds weight with seeds per plant had negligible value in F4(r=0.069) and weak one in F6(r=0.314), with seeds yield per plant highly significant in F4(r=0.881) and significant in F6(r=0.711).

Table5 Phenotypic correlation at F4 and F6 progenies

Characters	F4	F6	Characters	F4	F6
Plant height – HSW	0.656*	0.746*	HSW – no. S/Pl	0.069	0.314
Plant height – no. S/Pl	0.614*	0.202	HSW - SY/Pl	0.881**	0.711*
Plant height – SY/Pl	0.855**	0.506*	no. S/Pl - SY/Pl	0.533*	0.891**

**, **- significant at level P≤0.05 and P≤0.01*

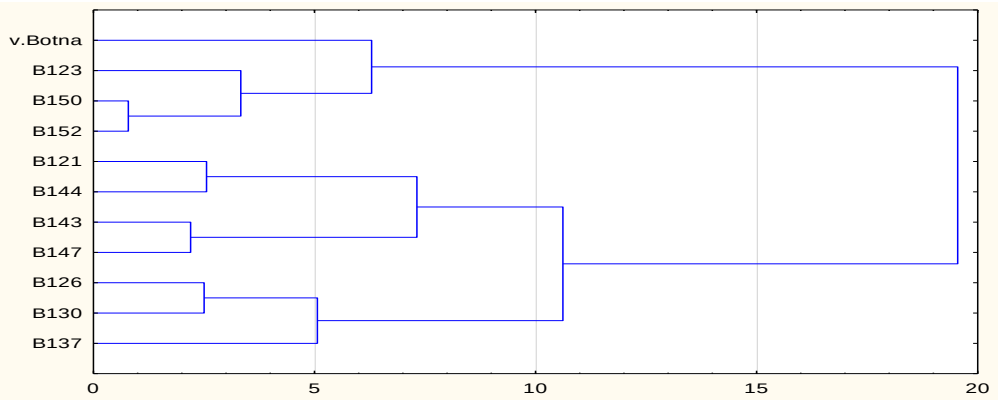


Figure1. Dendrogram of germplasm (F4 generation) based on 5 traits

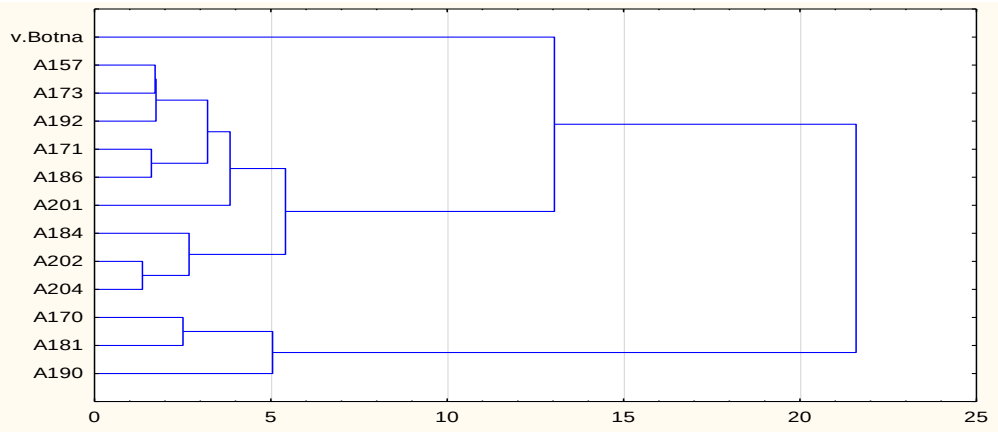


Figure 2. Dendrogram of germplasm (F6 generation) based on 5 traits

Between variables seeds per plant and seeds yield per plant were determined moderate association in F4(0.533) and highly significant in F6(r=0.891), (Table5).

Both dendrogram have been done by complete linkage method (Figure 1,2). In F4 generation germplasm were partitioned into 4 clusters: CL1 – v. Botna, B123, B150, B152; CL2 – B121, B144; CL3 – B143, B147; CL4 – B126, B130 and B137(Figure1). In F6 generation were formed 3 clusters: CL(I) – A157, A173, A192, A171, A186, A201; CL(II) – A184, A202, A204; CL(III) - A170, A181 and A190. Variety Botna did not enter any of the clusters but by yield/m^2 combined with CL(I) and CL(II), Figure 1,2.

Table 6. Mean performance of agronomic traits partitioning into clusters

CLs	Germplasm	Seeds /Pl	SY/Pl (g)	100-SW	Height Plant	SY/ M^2(g)	Maturity
2	B121,B144	32.13	8.44	26.3	51.0	121.9	19-21/7
4	B126, B130, B137	31.2	9.06	29.06	55.03	120.1	19-20/7
3	B143, B147	31.15	7.83	25.2	48.2	116.8	19-21/7
1	Botna, B123, B150, B152	29.42	7.39	25.12	47.85	105.6	18-20/7
III	A170, A181, A190	30.40	9.08	29.86	58.83	122.1	19, 22-23/7
II	A184, A202, A204	28.06	7.98	28.46	55.8	108.3	19-20/7
I	A157, A173, A192, A171, A186, A201	27.39	7.91	28.9	56.5	107.14	19-21, 22-23/7

Mean performance of agronomic traits by clusters presented in Table 6 in descending order of yield/m^2. In F4 generation germplasm pertaining to CL2 and CL4 were the most productive with mean yield 121.9g and 120.1g/m^2, respectively. Distinction germplasm of GL4 from CL2 are: the plants are a little taller, with larger seeds, and little difference into traits seeds and seeds yield per plant. Germplasm at CL3 intermediate by yield (116.8g/m^2) by seeds and SY/Pl, HSW and PH little inferior compared to germplasm of CL2. In cluster 1, entering germplasm B123, B150, B152 and v. Botna with mean productivity105.6g/m^2, them differ from CL3 a little reduce seeds and SY per plant. Maturity: germplasm of CL1 a little earlier than others one. In F6 generation 3 germplasm A170, A181 and A190 pertaining to Cl(III) with mean yield 122.1g/m^2 superior by yield other germplasm and v. Botna (108.3, 107.14g/m^2). Main advantage germplasm of Cl(III) compared to CL(II) and CL(I) are higher values of seeds and SY per plant. In F6 generation germplasm of CL(II) as well as A190, A157 and A173 by ripening were a little earlier than remaining. In generally late maturing is undesirable traits, of them only 2 out of 6 progenies had increased yield.

Number of fruit-bearing plants(FBP) traits that should also be taken into consideration. Analysis of FBP the F4 generation in clusters showed following mean values per m^2: 14.2, 14.52, 15.0 and 13.3 in clusters 1,2,3 and 4, respectively;

in F6 one – without significant difference (13.47 – 13.54). Thus, all germplasm of F6 and belonging to CL4(F4) had some reduced values.

CONCLUSIONS

As a result of evaluation breeding germplasm on yield/agronomic traits, were selected 22 progenies of them that superior the check was 7(B121, B144, B126, B130, B137, B143, B147) and 3(A170, A181, A190) germplasm in F4 and F6 generation, respectively. Analysis yield traits revealed that number of seeds and seeds yield per plant is the most significant. Plant height is significant coupled with hundred seeds weight, for most part of progenies increasing these traits enhanced yield per plant and per plot. Most (8 out of 10) of high yielded germplasm were middle matured, thus later maturing is undesirable trait.

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