Advances in Biology & Earth Sciences
Vol.2, No.3, 2017, pp.348-360

COMPARISON CHICKPEA (*Cicierarietinum L*) GENOTYPES AND ANALYSIS OF YIELD PERFORMANCE FOR DROUGHT CONDITIONS

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Abstract. Eight promising chickpea genotypes advanced from preliminary yield trial were evaluated for their yield performance, adaptability to moisture stress areas and seed boldness that fulfill the required standard for export from 2009 to 2013 cropping seasons. The standard checks Shaso and Arerti were used for comparison. The experiment was conducted at three locations, Sirinka, Chefa and Kobo using randomized complete block design with three replications. Farmers were involved in the evaluation of the candidate genotypes on-farmers field. A workshop was prepared on food preparation, nutritional and utilization aspect of the crop. Female and male farmers were involved during the training. The combined analysis of variance over years and locations revealed that there was highly significant difference among chickpea genotypes in days to flowering, days to maturity, number of pods per plant, 100 seed weigh and seed yield. Based on the analysis of genotype ICC-14808 were found an outstanding in all agronomic and yield performance. These genotypes were evaluated, validated and verified for release by the National Variety Releasing Committee for the region. The yield potential of the genotype was 3.7 tons ha^{-1} at research station. ICC-14808 genotypes have a 45% of yield advantage over the standard check (Shasho). This candidate variety are bold seeded (35gm) of 100 seed weight that fulfilled the required standard for export. Besides, these varieties were drought tolerant and grow in area where all other cool season pulse crops couldn't grow very well. They can escape the terminal drought. Based on the evaluation and assessment of the national variety-releasing committees, they released the genotype ICC-14808 (Yelbe) for Sirinka, Chefa, Kobo and similar agro-ecology. Farmer's assessment for agronomic and other criteria for this variety was highly preferred as compared to the standards checks. The nutrient content were tested by EBI laboratory and had 28.2 % of proteins; 54% per 100 gram of the flour were carbohydrate. Acceptability and utility for easiness, flour yield, easiness for chewing, flavor attractiveness, boiling time at 92^0C, roasting rate (degree of non-sucker), roasting ability, quality and color were evaluated by recipe farmers and preferred in those quality assessments.

Keywords: *chickpea, Cicierarietinum L., yield performance, utilization and nutritional assessment.*

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Manuscript received*: 3 November 2017*

1. Introduction

Chickpea (C*icerarietinum L.*) was classified in the tribe *Cicereae* Alef (Kupicha 1977 [4]; Nozzolillo 1985 [8] cited in Van Der Maesen, 1987 [14]). It is one of the first grain legumes to be cultivated in the old world. The crop originated in the present southeastern Turkey and along its boundary with Syria (Vavilov, 1926, [15] 1949-1950; cited in Van Der Maesen, 1987). World-wise chickpea cultivation accounts for 15% of the land area cultivated to all pulses and 13% of pulses production of (FAO 1982, cited in Judah and Subbarao, 1987). Among the major pulses produced in Ethiopia, chickpea ranks second in production next to faba bean (Asfaw *et al.*, 1994). It is used as a human food and animal feed, and in particular, chickpea serves as an important protein supplement in the cereal-based diet of most Ethiopians (Senayit, 1990 [10] and Saghfi *et al.,* 2014 [9]). Indicated that, it is an excellent source of protein (20-40%), which is approximately three times that of cereals. The protein in chickpea seed is rich in the amino acids, lysine and tryptophan, compared to cereal grains; however, it is deficient in methionine and cystine when compared to animal proteins. The consumption rate increases during the fasting days, when the Orthodox Christians abstain from meat and egg and other animal products (Senayit, 1990 [10]). Besides its food value, chickpea helps in the management of risk aversion where there is crop failure of major cereals due to recurrent drought. It also helps in soil fertility management, particularly in dry land areas, through symbiotic nitrogen fixation.

Among the major biological constraints and the degradation threats that limit the production and wide coverage of chickpea production was low productivity of the crop at farmer’s level, absence of kabuli chickpea variety that fulfills the required standard for export in the region, farmers preference inclined for the Desi type due to the productivity per unit area and lack of awareness for the nutritional and utilization aspect of the crop for home consumptions. In this regard, the National Chickpea Improvement Program has made several efforts to identify the major constraints of chickpea production. According to the working document of the national crop research strategy (2000), high priorities were given for development of variety that is resistant for drought, wilt/root rot, which are important bottlenecks in the chickpea production. So the research should focus on selecting and improving yield potential of the *Kabuli* genotype that fulfilled the required standard for export and resistance or tolerance to factors that reduce the yield of chickpea. In the recent agricultural policy, developing marketable commodity crop is the primary research agenda. Due to the scarcity of genetic variability and partly to the less attention in making crosses, attempted to improve this crop have, therefore, been mostly confined either to the examination of varietal difference or selection from the cultivars improved stocks (Singh and Malhotra, 1984 [12]; Van Der Maesen, 1984 [14]; Muehlbauer and Singh, 1987 [6]; Siamak et al., 2016 [11]). At the early stage of this study large samples of single seed decent pure lines were evaluated and selected in a single location. In light of this the present study is aimed to develop and select high yielding, bold seeded chickpea that fulfilled the required standard for export and relatively early maturing genotype that can do well in the terminal moisture stress area of the region. In the second phase of the activity study deals with the nutritional values and utilization of the crop have been studied through the participation of the farmers and home scientist.

2. Materials and methods

The experiment was conducted at three sites in the major chickpea growing areas of the northeastern part of Ethiopia. It includes North Welo (Kobo represent lowland altitude and Sirinka represent intermediate altitude) and Oromya Zone (Chefa represent sub-humid lowland) (Table 1). Eight genotypes of chickpea (kabuli type) advanced from preliminary yield trial, and two standard varieties (*Sasho and Areti*) were included for the study. The experiment was carried out in randomized complete block (RCB) design replicated with three times, on a plot size of 2.4 m wide and 4 m long. A row- to -row distance of 40 cm and plant-to-plant distance of 10 cm were maintained. The material was sown in the first week of September in 2009 and 2010 cropping season. Data were recorded on nine important phonological and yield component characters. The observations were recorded on ten randomly selected plants for three traits on plant basis and rest data were taken from the four harvestable rows were considered on plot basis. Plot means were used to estimate the mean performance of the genotype. Fertilizer was not applied. Seedbed preparation has been done three times; hand weeding was carried out two times. In the 2012 cropping season the two promising candidate genotypes were evaluated on both station and on-farmers field with a plot size of 10m by 10m. Farmers' assessment and evaluation were included in the data. Seed samples of the candidate varieties were taken to the EBI laboratory for nutrient and quality assessment. In the 2013 utilization and nutritional quality assessment were done through participatory evaluation of 20 women and 20 men farmers. The utilization assessment includes the flour yield, boiling time, roasting rate, test and *shiro* color. For the nutritional quality analysis Melkassa ARC food science department and Combolcha agricultural technology institute also involved.

Table 1. Geographical, climatic and agro- ecological features of the experimental sites

	Location		
	Kobo	Sirinka	Chefa
Major agro-ecology	SM1-3	M1-7	M1-3
Mean range of temp. (^{0}C)	25-38	21-32	21-36
Mean annual rainfall (mm)	660	876	850
Altitude (masl)	1450	1850	1680
Latitude	12.12	12.11	10.89
Soil type	Sandy loam (Brown)	Black soil	Black soil
Distance from Addis Ababa in km	570	508	355

Source. (*Natural Resource Management and Regulatory Department, MOA, 1998*)

Analysis of variance

The collected Data were subjected to analysis of variance (ANOVA) using Gen Stat Release 8.1computer software program. To compute variance components for each location and combined analysis across locations, the analysis of variance was carried out using the formula outlined by Miller *et al.* (1959).

3. Result and discussion

The combined analysis of variance across location and year showed that there was significant differences among the genotype in days to 50% flowering, days to 90% maturity, number of pods per plant, number of seeds per pod, 100 seed weight in gm, plant height, seed yield in kg per hectare and harvest index (data not shown). The mean range for days to 50% flowering was 35 to 76 days. The earlier genotype mature within (74 days) and the longest mature for (144 days) (Table 2). The maximum number of pods per plant was recorded (142 pods) and the minimum was (2 pods). The smallest 100 seed weight in gm was recorded (18 gm) and the largest was (43 gm). The lowest seed yield was recorded (0.3 tones ha^{-1}) for genotype *Arerti* and the highest was (3.8 tones ha^{-1}) for genotype *FLIP-93-195C.* The minimum harvest index was (1%) and the maximum was (59%) (Table 2).

The AMMI combined analysis of variance for days to 90% maturity showed 77% of the variation was explained by the difference among environment main effect, 17% by the genotype main effect and 5% by GE interaction (Table 3). Among the genotypes FLIP-95-31C, ICC-14808 and FLIP-93-195C were early maturing the can escape the terminal drought (Table 4). Cluster analysis also showed that, these genotypes belong to the same clustering group (Data not shown). In most biplot presentation when the genotype and an environment have the same sign on the PCA axis, their interaction is positive; if different, their interaction is negative. If a genotype or an environment has a PCA score or nearly zero it has small interaction effects and hence can be fitted well by additive model (Zobel et al., 1988; Gauch and Zobel, 1997 [2]).

The additive main effect and multiplicative bi-plot showed that the seasonal effects were very influential as compared with other source of variation (Table 4). The combined analysis of variance across location of the AMMI model showed that there were significance differences among the genotype in seed yield in kg ha^{-1}. 81% of the variation was explained by the difference by environment main effect, 10% by the difference among the genotype main effect and 9% by GE interaction (Table 7). The genotype performs differentially across six environments, but the interaction was quantitative. That is to say the genotype have non-cross over interaction.

Table 2. Range, Mean, CV in % of yield and yield component data of tested genotype

Identifier	Minimum	Mean	Maximum	CV%
DF	35	48.63	76	10.31
DM	74	99.61	144	4.08
NP	2	36.87	142	30.46
NS	1	1.2	3	27.9
PH	23	41.98	75	7.54
SW	18	31.93	43	8.66
BI	200	1594	4200	21.79
Seed yield in kg/ha	31	1352	3782	19
HI	1	26.51	59	17.15

Table 3. ANOVA table for AMMI model for days to 90% maturity

Source	df	SS	MS	F	F_prob
Total	179	56959	318	*	*
Treatments	59	54992	932	56.4	0
Genotypes	9	9513	1057	63.9	0
Environments	5	42479	8496	563.3	0
Block	12	181	15	0.9	0.54
Interactions	45	3000	67	4.0	0
IPCA	13	2355	181	11.0	0
IPCA	11	289	26	1.6	0.11
Residuals	21	356	17	1.0	0.44
Error	108	1786	17	*	*
Error	108	1786	17	*	*

Table 4. Mean performance of the genotype for days to 90% maturity across locations

Genotype	**Sirinka**	**Chefa**	**Kobo**	**Sirinka**	**Chefa**	**Kobo**	**Grand Mean**
FLIP-93-22C	111.3	90	78.3	104.7	80.3	85	91.6
FLIP-93-195C	110.7	89.3	75.3	105	81	84	90.9
ICC-12339	120.6	97.3	81	129	90.3	98.7	102.8
FLIP-95-31C	106	89.7	77.3	106.3	80	82	90.2
ICC-14808	106	88.7	77.3	106.7	81.7	83.3	90.6
FLIP-95-39	130.7	99.3	84.3	132	89	96	105.2
FLIP-94-119C	124.1	96	91.3	135.3	89.7	99.3	106
FLIP-96805	133	90.3	88	137.7	90.3	102.7	107
Arerti	130.6	98.3	89	135	90.3	100.3	107.3
Shaso	127.1	98	88	122	91	101.7	104.6
MEAN	120	93.7	83	121.4	86.4	93.3	99.62
CV	7.17	2.06	1.8	2.67	1.05	3.03	4.08
LSD (5%)	14.76	3.3	2.56	5.55	1.56	4.82	**

The IPCA score showed that FLIP-94-119C and FLIP-93-22C were more stable across eight environments (Fig. 1). However, FLIP-94-119C was associated with low yield (Table 8). Genotypes ICC-14808, FLIP-93-195C and FLIP-95-31C were high yielder in all eight environments (Fig. 1). AMMI biplot showed that high yield was recorded at Sirinka and Chefa in 2009 and 2010 cropping season, respectively (Fig. 2).

Table 5. ANOVA table for AMMI model for days to 100 seed weight in gm

Source	df	SS	MS	F	F_prob
Total	179	5927	33.11	*	*
Treatments	59	4953	83.95	10.99	0
Genotypes	9	3990	443.31	58.04	0
Environments	5	382	76.45	6.15	0.00005
	12	149	12.43	1.63	0.0945
Interactions	45	581	12.92	1.69	0.01436
IPCA	13	275	21.16	2.77	0.00195
IPCA	11	210	19.1	2.5	0.00771
Residuals	21	96	4.57	0.6	0.91184
Error	108	825	7.64	*	*

Table 6. Mean performance of the genotype for 100 seed weight in gm across locations

Genotype	Sirinka	Chefa	Kobo	Sirinka	Chefa	Kobo	Genotype Mean
FLIP-93-22C	37.12	38.46	33.42	41.66	37.23	35.11	37.17
FLIP-93-195C	32.07	37.59	33.16	37.65	35.27	29.25	34.17
ICC-12339	19.93	22.01	20.39	18.76	21.65	22.92	20.94
FLIP-95-31C	33.06	36.93	34.01	35.1	35.61	33.29	34.67
ICC-14808	32.89	36.86	34.03	34.83	35.53	33.2	34.56
FLIP-95-39	31.21	36.45	33.8	33.47	34.79	31.27	33.5
FLIP-94-119C	30.27	34.1	32.87	29.29	33.34	33.14	32.17
FLIP-96805	30.01	39.58	37.69	33.07	36.84	29.48	34.44
Arerti	24.74	26.78	22.35	28.56	25.53	23.37	25.22
Shaso	31.37	34.23	31.28	32.94	33.2	31.98	32.5
Location Mean	30.27	34.3	31.3	32.53	32.9	30.3	31.9
CV	7.4	4.05	4.85	11.75	3.33	15.1	8.66
LSD (5%)	3.84	2.38	2.6	6.54	1.89	7.82	*

Generally, we can conclude that the environment showed high variability both in mean yield and interaction patter, but Sirinka (2009) and Chefa (2010) were found to be more favorable environment for all genotypes. On average Kobo was a low yielding environment; this was due to the low moisture, most of the genotypes do not perform well at Kobo (Table 8). On both Fig.1 and Table 9 ICC-14808 out yielded all the genotypes at four environments.

Based on AMMI analysis, either a more or less stable genotype relatively associated with high yield or specifically adaptative variety can be recommended for each mega-environments. Genotype ICC-14808, has high average mean yield. In addition the AMMI model selects genotype ICC-14808, was the first rank across four environments and the third ranks in one environment. In spite of AMMI selection per environments, farmers evaluate genotype in there conditioning environment that is drought. They gave attention to additional merits of the genotypes besides to earliness; among them pod load, seed boldness and seed yield were important parameter for selection. Genotype, ICC-14808, because of their earliness and pod load, farmer prefer this genotype at Sirinka and Chefa.

The candidate genotypes verified on both station and on-farmer's field in the 2011 cropping season and evaluated by variety releasing technical committee and host farmers. Due to severe drought for this cropping season the candidate varieties at Chefa were not evaluated. The analysis of variance across the two locations indicated that candidate variety ICC-14808 followed by *arerti* perform better in their yield. According to farmer's evaluation, they preferred variety ICC-14808 and FLIP-93-22C in accordance as compared to standard and local checks in their earliness and yield. Those candidate varieties fulfilled the required standard of seed boldness for export. It is a means of cash income for the farmers, if they scaled up in there farming system. Besides the combined analysis of verification trial in 2011 showed that the candidate variety out yielded the standard check by 22% (Table 10). The candidate variety ICC-14808 (*Yelbe*) has been selected and released by the variety release committee for Sirinka, Mersa, Chefa and Kobo and similar agro-ecology. Based on this recommendation Research and extension division has to demonstrate and popularize the variety with in recommended domains.

Table 7. ANOVA table for AMMI model of the genotype for seed yield in kg per hectare

Source	df	SS	MS	F	F_prob
Total	179	159887630	893227	*	*
Treatments	59	151371610	2565621	38.69	0
Genotypes	9	14330141	1592238	24.01	0
Environments	5	123145954	24629191	218.34	0
Block	12	1353604	112800	1.7	0.07632
Interactions	45	13895515	308789	4.66	0
IPCA	13	8926060	686620	10.35	0
IPCA	11	3045233	276839	4.17	0.00004
Residuals	21	1924222	91630	1.38	0.14364
Error	108	7162417	66319 *	*	

Table 8. Mean Seed yield in kg per hectare of the genotype across eight environments

		2009			2010			Grand Mean
	Genotype	Sirinka	Chefa	Kobo	Sirinka	Chefa	Kobo	
1	FLIP-93-22C	2663	1504.8	1344.8	802	2317.8	196.9	1471.5
2	FLIP-93-195C	3146.5	1532.4	1646.9	906.8	2551.9	233.3	1669.6
3	ICC-12339	2317.8	1301.9	1465.6	1572.6	2455.4	91.7	1534.2
4	FLIP-95-31C	2741.5	1439.7	1338.6	842.2	2807	243.8	1568.8
5	ICC-14808	3660.1	1831.7	1321.9	685.6	2780.6	354.2	1772.3
6	FLIP-95-39	1987.4	482.9	767.7	821	1889.8	128.1	1012.8
7	FLIP-94-119C	2816.3	578.1	539.6	703.6	1625.8	158.3	1070.3
8	FLIP-96805	1936.8	694.9	497.9	1199.1	1761.9	95.8	1048.5
9	Arerti	2890.4	854.8	1313.6	632.7	2576.1	71.9	1389.9
10	Shaso	1964.7	446	582.3	973.5	1613.5	110.4	983.1
	MEAN	2612.4	1066.7	1081.9	913.9	2237.98	168.4	1352.117
	CV	13.74	20.86	23.01	23.79	15.77	30.82	19
	LSD (5%)	615.6	381.7	355.5	372.9	605.5	119.2	**

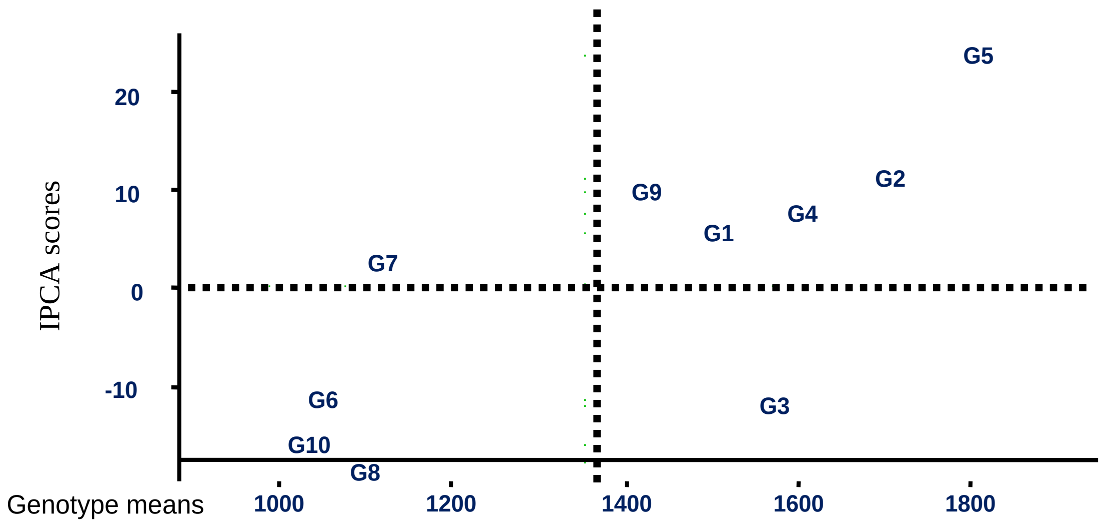

Fig 1. Genotype IPCA 1 scores versus the means performance across six environment

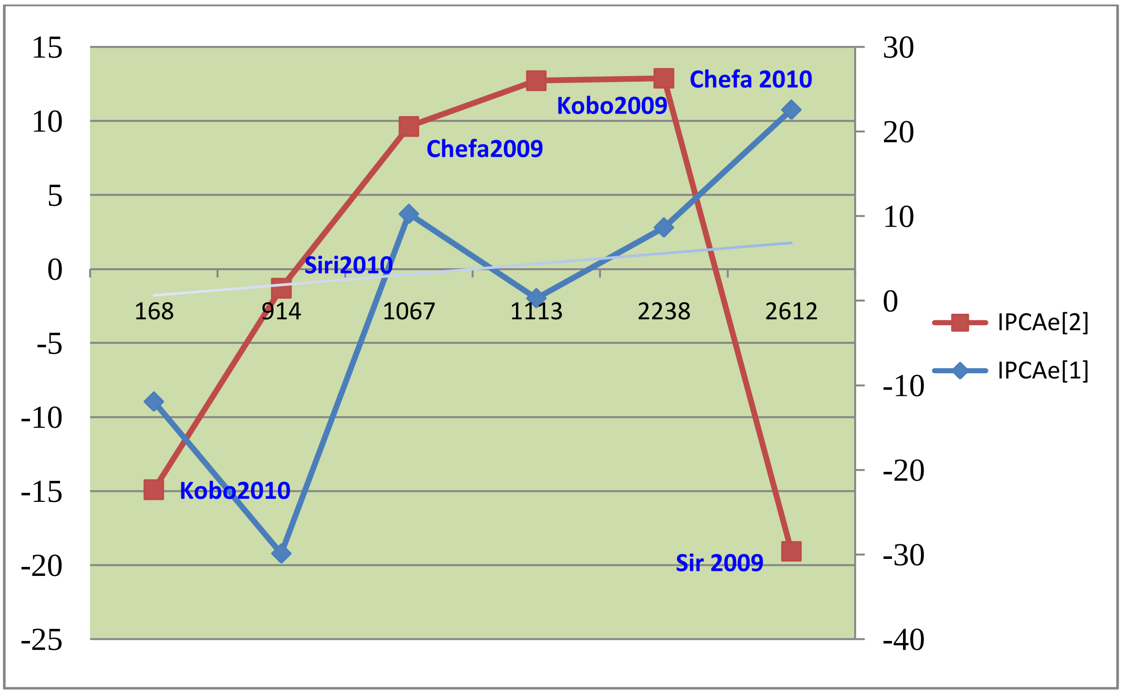

Fig 2. Environment IPCA 1 scores versus the means performance of each environment

Table 9. The first four AMMI selections per environment

Number	Environment	Mean	Score	1	2	3	4
1	E1	2612	22.58	G5	G2	G9	G4
2	E2	1067	10.26	G5	G2	G4	G1
5	E5	2238	8.66	G5	G2	G4	G3
3	E3	1113	0.3	G2	G3	G5	G4
6	E6	168	-11.92	G5	G2	G3	G7
4	E4	914	-29.88	G3	G8	G10	G6

Table 10. Kabuli Chickpea Variety Verification Trial Combined across the Three locations

CANDIDATE GENOTYPE	DF	DM	*NP*	NS	SCH	PH	SW	AYKGHA	RANK
FLIP-93-22C	44	100	48	1.3	902.7	45	37	838	2
ICC-14808	47	101	61	1.8	737.7	40	38	934	1
Arerti	59	119	53	1.3	925.4	41	31	837	3
Shaso	57	116	39	1.3	781.1	43	34	725	3
GRAND MEAN	52	109	50	1.4	836.8	42	35	833	
CV%	5.3	3.5	36	23.5	19.7	9.1	6.9	29	26
LSD	3.1	4.2	NS	NS	NS	NS	2.7	NS	1

Utilization and Nutritional Assessment

Both women and men farmer were involved in the nutritional and utilization assessment of the candidate variety. The following nutritional and utilization aspect were evaluated such as *nifro*, *shiro* and flour yield. As to the quality aspect, they considered color, test, flavor, boiling time and roasting rate. Farmer's assessment and the result were displayed on (Table 10, 11, 12, 13).

Table 11. Nutritional quality analysis of the candidate varieties

Variety	%Protein	% Carbohydrate	% Fat	% Crude fiber	% Mineral ash	% Moisture
ICC-14808	28.43	50.9	1.1	5.9	3.89	9.66
Arerti	26.12	50.1	1.14	6.83	4.33	9.53
Shaso	27.79	51.96	1.05	5.77	4.01	9.42

* Based on the dry matter

The assessment of *nifro*, farmer's involved in testing for easiness, easiness for chewing and flower attractiveness as an important criteria for *nifro* quality of the varieties. Based on their evaluation most of the farmers are very impressed and attracted in those test parameters. In addition they highly prefer dry rosted recipe form commonly called "***Kolo***"and their imbibitions for (variety **ICC-14808**) during roasting with water. They are also preferred cream color of the *Nifro*.

The second quality parameter; they considered the color of the *shiro* after decorticated. All the three verities have a typical *shiro* color. But some farmers have comment to adjust the redness of flour color. According to the home scientist the color can be adjusted by the amount of spices and pepper added in the flour (Table 13). The other important quality parameter is the roasting ability of the seed, this is because they directly correlate with the amount of fuel required to boiled the seed. Based on their evaluation variety ICC-14808 boiled with short time relatively and has very low number of non-suckers. But variety local desi variety have long period of time required to roast and have high number of non-sucker count as compared with the other two kabuli varieties (Table 12).

Table 12. Consumer evaluation of the *Nifro* character of the Kabuli Chickpea varieties

Variety	Number of farmers	Testing easiness			Easiness for chewing			Flavor attractiveness		
		Very good	Good	Poor	Very good	Good	Poor	Very good	Good	Poor
ICC-14808 ***(Yelbe)***	40	36	4	0	40	0	0	36	3	1
Shasho	40	35	5	0	40	0	0	36	3	1
Local Desi variety	40	34	5	1	32	8	0	38	2	0

Table 13. Color: Farmers assess the color of the *Shiro* after flour.

Varieties	**Total numbers of farmers**		**Typical shiro**		**Too red**		**White**		**Remark**
	Male	Female	Male	Female	Male	Female	Male	Female	
ICC-14808 ***(Yelbe)***	20	20	8	3	2	17	0	0	
Shasho	20	20	6	12	2	8	0	0	2 reserved
Local mixed with all pulses	20	20	10	15		5	0	0	

Table 14. Roasting and cooking time of cow pea varieties

Varieties	**Boiling time at 92^{0}C**	**Roasting rate (degree of non-sucker)**	**Roasting ability**
ICC-14808 ***(Yelbe)***	4.10-3.30=0.40	Excellent	1
Shasho	4:25-3:30=0:.55	Very good	1
Local desi variety	4.45-3.30=1.15	Good	2

Table 15. Test of the *Shiro* wet

Varieties	**Total numbers of farmers**		**Too testy**		**Good**		**Not testy**		**Remark**
	Male	Female	Male	Female	Male	Female	Male	Female	
ICC-14808 ***(Yelbe)***	20	20	5	5	0	3	-	2	-
Shasho	20	20	5	5	0	3		2	-
Local mixed with all pulses	20	20	15	20	5				

Table 16. Flavor character of the varieties

Varieties	**Total numbers of farmers**		**Slightly sour**		**Sour**		**Slightly sweet**		**Slightly bitter**		**Bitter**	
	Male	Female	Male	Female	Male	Female	Male	Female	M	F	M	F
ICC-14808 ***(Yelbe)***	20	20	5	7	7	6	8	7	0	0		
Shasho	20	20	5	5	7	7	8	8	0	0		
Local mixed with all pulses	20	20	12	10	7	10	1	0	0	0		

Table 17. General acceptance of the varieties according to the opinion of the farmers after cooking and testing *Shiro wet*

Varieties	**Total numbers of farmers**		**Excellent**		**V. good**		**Good**		**Fair**		**Poor**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**M**	**F**	**M**	**F**
ICC-14808 *(Yelbe)*	20	20	8	6	6	6	6	6		2		
Shasho	20	20	7	6	6	6	6	10	1			
Local mixed with all pulses	20	20	8	10	6	8	6	2				

The female Farmers have additional character, they including the flour yield that they commonly called it (*Wuha yanesal*)

Most farmers gave the best Shiro rank for the local mixed pulses. The local Shiro was prepared from flour mix with field pea and grass pea. But in the case in Nifro, most of the consumer prefer varieties ICC-14808 (Yelbe), because of the attractiveness of the smell and sweet as compared to local Desi.

3. Conclusion

The choice of a particular population will depend on the mean performance of the population and the genetic variability within the population. Thus, eight genotype introduced from ICARDA including the standard check *Shaso and Arerti* genotypes were evaluated for their yield in the moister stress area of the Eastern Amahra, and their utilization under the farmer's condition were evaluated at Sirinka, Chefa and Kobo testing sites starting from 2009 to 2013 years using randomized complete block design with three replications. Yield seed boldness and earliness was taken as important criteria in selecting the desirable genotypes for the region. In the utilization assessment farmers and food scientist professionals were fully involved in the evaluation.

The analysis of variance showed significant differences among the genotypes for all the traits considered, signifying the existence of sufficient variability for improvement. Number of pods per plant, number of seeds per pod, 100-seed weight, days to 50% flowering, days to 90% maturity, plant height and seed yield showed a wide range of variation at individual environments and in the combined data across locations. Additive main effect and Multiplicative Interaction (AMMI) analysis was used to understand the Genotype X Environment interaction pattern, since it increases precision of yield estimate, and helps to form more cohesive cluster of environments and genotypes compared to unadjusted mean model. The result exhibited significant environment and genotype main effect and high genotype by environment interaction effect. AMMI analysis showed that genotype ICC-14808 is the first candidate across five environments. It has 35 gm 100 seed weight in gram, which fulfilled the required standard for export. ICC-14808 (*Yelbe*) is released for Sirinka, Chefa, Kobo and similar agro-ecology. The Research and Extension Research division has to demonstrate and popularise the variety for the end users.

Due to less awareness of the crop for the community a workshop were prepared to train and capitalize food, nutritional values and utilization of the crop. Both female and male farmers were involved in the evaluation process. Farmers were impressed and interested to utilize the varieties after the training and their participatory evaluation. They test both quantitative and the qualitative aspect of the nutrition aspect of seed of the variety. They appreciate the Nifro, testing for easiness, easiness for chewing, flower attractiveness, boiling time, roasting rate, test of the *Shiro wet*, color of the *shiro the kabuly variety.*

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