Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.4, No.18, 2014

Adaptation Study of Improved Kabuli Chickpea (Cicer Arietinum L) Varieties at Kellem Wollega Zone, Haro Sabu, Ethiopia

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Abstract
The present study was envisaged to assess the adaptability of four improved Chickpea (Cicerarietinum L) varieties (Arerti,Monino, Shasho, Ejere and a local check (Harere) at Haro Sabu Agricultural Research Center sub sites, to see their adaptability potential under western Oromia. These varieties were sown in RCBD with three replications during 2013/14 at Hawa Galan and Tabor sub sites. Combined analyses of data from the two experimental sites(Hawa Galan and Tabor)revealed very highly significant varietal differences ($P < 0.05$) in grain yield, days to 50% flowering and days to 95% maturity, seed per pod and hundred seed weight and significant for plant height. However, no significant varietal differences were observed in main branch per plant and pod per plant. The location effect was highly significant ($P < 0.05$) for hundred seed weight and significant for plant height. There were no significant differences between the two locations with respect days to 50% flowering, days to 95% maturity, main branch per plant, pod per plant, seed per pod and yield. The replication across location effect was not significant ($P < 0.05$) for all characters studied. A variety x Location interaction effects was highly significant ($P < 0.05$) only for hundred seed weight. Regarding the mean performances of varieties over the two locations, Arerti was the highest in grain yield (20.1 Qt ht^{-1}), followed by Shasho (19.8 Qt ht^{-1}).On the contrary, the lowest grain yield was obtained from Monino (5.2 Qt ht^{-1}).
Keywords: Chickpea (Cicerarietinum L); varieties; adaptability

1. INTRODUCTION

Chickpea (*Cicerarietinum* L) belongs to the family Fabaceae (earlier Leguminoseae) and sub family papilonaceae (Kupich, 1977). Among food legumes worldwide Chickpea (*Cicer arietinum* L.) is second in production next to the common bean (*Phaseolus vulgaris* L.). During 2010, the global chickpea area was 12.0 million ha, production was 10.9 million metric tons and yield was 913 kg ha−1 [FAOSTAT 2012]. Southern and South-Eastern Asia accounts for 79% of the global chickpea production. India is the largest chickpea producing country, with 68% of world chickpea production. The other major chickpea producing countries include Ethiopia, Australia, Pakistan, Turkey, Myanmar, Iran, Mexico, Canada and USA.

Chickpea is used as supplies of food for human being (Yetneberk, 1990 and Westphal, 1974) and used in rotation with several cereals like barley, tef or wheat (Westphal, 1974; Debela *et al.* 1987; Bejiga *et al.*1996). An average chickpea yield on farmers field is usually below 1t/ha although its potential is more than 5t/ha (Jagdish *et al.* 1995; Bejiga *et al.* 1998). This is resulted from lack of improved varieties and susceptibility of landraces to frost, drought, water logging and poor cultural practices; low or no protection measures against weeds, diseases and insect pests (Tilaye *et al.* 1994; Bejiga *et al.* 1996). Currently the number of chickpea importing countries has increased from 64 in 1990 to 142 in 2009 [FAOSTAT 2012] suggesting increasing global demand of the chickpea. The usage of improved seeds is one of the most efficient ways of raising crop production, but in Ethiopia less than 10 percent of farmers use improved seeds (FAO, 2010).

However most of the cultivated especially extra-bold-seeded Kabuli varieties are poorly adapted. Lack of access to improved varieties in western part of Ethiopia is the main problem that hampers production of this crop. Therefore, the present study was envisaged to assess the adaptability of improved Kabuli chickpea varieties that gives best yield under agro ecology of western Oromia.

MATERIALS AND METHODS

Description of the Experimental Site and Experimental Design

The experiment was conducted in western Oromia, kellem wollega Zone, at Haro Sabu Agricultural Research Center Sub-sites Hawa Galan and Tabor, which has an altitude of 1550 m.a.s.l. The soil type of the experimental site is clay loam soil.

The experiment was conducted on four chickpea varieties(Arerti, Monino, Shasho, Ejere and a local check (Harere). These varieties and check variety were sown in RCBD with three replications during 2013/14 at Haro Sabu Research Center Sub-Site Hawa Galan and Tabor, Ethiopia. Experimental unit comprised Six rows of 3 meters length with row-to-row distance of 40 cm and plant-to-plant distance of 10 cm. Data were collected from randomly selected and tagged plants from the central rows excluding the border rows .Data were recorded for grain yield and its components including days to 50%flowering, days to 95% maturity, stand count at harvest, plant height (cm), number of primary branches per plant, and number of pods per plant, seed per pod, hundred

seed weight and yield. The data were subjected to statistical analysis using SAS 9.1 computer software. The significance of means differences were tested by Duncan's Newman Multiple Range Test (DNMRT) as stated in Gomez and Gomez (1984

RESULTS AND DISCUSSIONS

Analysis of variance

Analyses of variance have been done for grain yield and other agronomic traits; days to 50% flowering, days to 95% maturity, plant height, main branch per plant, pod per plant, seed per pod and hundred seed weight. The results of analysis of variance based on randomized complete block design experiments for Hawa Galan and Tabor sub-sites location are presented in Appendices 1 and 2, respectively and for combined one is presented in Appendices 3. Under Hawa Galan (Appendix 1), the mean of squares due to varieties were highly significant for days to 50% flower and significant for all other traits expect main branch per plant .under Tabor (Appendix 2), the mean of squares due to varieties were highly significant difference for hundred seed weight and significant for days to 95% maturity, seed per pod and yield.

Variations in grain yield and other agronomic traits

Combined analyses of data from the two experimental sites(Hawa Galan and Tabor)revealed very highly significant varietal differences ($P < 0.05$) in grain yield, days to 50% flowering and days to 95% maturity, seed per pod and hundred seed weight and significant for plant height. However, no significant varietal differences were observed in main branch per plant and pod per plant (appendix 3).

The location effect was highly significant ($P < 0.05$) for hundred seed weight and significant for plant height. There were no significant differences between the two locations with respect days to 50% flowering, days to 95% maturity, main branch per plant, pod per plant, seed per pod and yield (appendix 3).The replication across location effect was not significant ($P < 0.05$) for all characters studied.

A variety x Location interaction effects was highly significant ($P < 0.05$) only for hundred seed weight. Regarding the mean performances of varieties over the two locations, Arerti was the highest in grain yield (20.1 Qt ht^{-1}), followed by Shasho (19.8 Qt ht^{-1}).On the contrary, the lowest grain yield was obtained from Monino (5.2 Qt ht^{-1}). PM Gaur et al (2005) conducted study on chickpea varieties ICCV 92318, Arerti and local check across location and season and reporting that Arerti (28.6 Qt ht^{-1}) was best yielder, and this findings also collaborate it.

The variety with the highest grain yield (Arerti) was earliest in days to flowering (63.8 days), and the earliest for days to maturity (111.8 days). The other variety which was the second highest grain yielder (Shasho) was intermediate in days to flowering (67.8 days), and earliest for days to maturity (111.8 days) (Table 3). Ejere differ from the rest of the tested varieties by being short by height, late to mature (118 days) and having highest seed per pod. On other hand, Monino differ from the rest of the tested varieties by its weight (48g per 100 seed) and this reveals this variety to be extra-large seeded Kabuli type (PM Gaur et al, 2006). PM Gaur et al, (2006) also reported that none of the Kabuli chickpea varieties was released to date in India has seed size larger than 40 g per 100 seed until 2006. Accordingly, depending on their hundred seed weight the rest of varieties namely Shasho, Arerti, Harere, and Ejere rely under medium-seeded Kabuli type (~25 per 100 seed) (PM Gaur et al, 2006).

Table 1. Mean values of yield and yield components of chickpea varieties at Hawa Galan

varieties	DTF	DTM	PHT	BRPP	PPP	SPP	HSW	YLDPHQ
Shasho	68.0^{a}	112.7^{b}	62.27^{a}	3.5^{a}	68.5^{a}	1.42^{ab}	30.27^{bc}	19.93^{a}
Arerti	64.0^{b}	112.0^{a}	61.07^{a}	3.2^{a}	56.1^{ab}	1.09^{bc}	29.20^{bc}	19.67^{a}
Monino	62.7^{bc}	109.3^{c}	57.27^{a}	3.2^{a}	29.0^{c}	1.10^{bc}	58.67^{a}	6.77^{c}
Harere	61.3^{c}	110.0^{bc}	57.27^{a}	4.2^{a}	68.0^{a}	0.84^{c}	26.77^{c}	16.27^{ab}
Ejere	64.0^{b}	118.0^{bc}	40.40^{b}	4.0^{a}	39.5^{bc}	1.86^{a}	36.03^{b}	13.73^{b}
Lsd(5%)	1.48	3.3	9.97	1.2	164.2	0.5	8.77	5.29
SE(m)	0.62	3.07	28.04	0.4	24.1	0.06	21.70	7.90
Cv(%)	2.96	2.04	10.08	17.44	51.97	17.92	5.30	21.60

*Means with the same letter are not significantly different. DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BRPS =Number of primary branches per stand, PPP=pod per plant, SPP =Seed per pod, HSW =Hundred seed weight, YLDQ =yield per hectare (Qt)

Table 2. Mean values of yield and yield components of chickpea varieties at Tabor

varieties	DTF	DTM	PHT	BRPP	PPP	SPP	HSW	YLDPHQ
Shasho	66.3^{a}	111.0^{b}	53.47^{a}	4.3^{a}	51.23^{a}	1.43^{ab}	21.8^{c}	19.73^{a}
Arerti	63.7^{ab}	111.7^{b}	50.20^{a}	3.6^{a}	60.40^{a}	1.20^{bc}	28.1^{b}	20.57^{a}
Monino	62.7^{b}	109.3^{b}	53.00^{a}	3.9^{a}	46.07^{a}	0.90^{c}	37.4^{a}	3.67^{c}
Harere	62.7^{b}	111.3^{b}	51.80^{a}	4. 7^{a}	54.37^{a}	1.30^{bc}	26.9^{b}	15.60^{ab}
Ejere	64.0^{ab}	118.0^{a}	40.40^{b}	4.0^{a}	39.47^{a}	1.87^{a}	36.0^{a}	13.73^{b}
Lsd(5%)	3.56	4.31	9.45	1.34	49.22	0.45	2.99	5.96
SE(m)	3.57	5.23	25.19	0.51	683.5	0.06	2.53	10.03
Cv(%)	2.96	2.04	10.08	17.44	51.97	17.92	5.30	21.60

*Means with the same letter are not significantly different. DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BRPS =Number of primary branches per stand, PPP=pod per plant, SPP =Seed per pod, HSW =Hundred seed weight, YLDQ =yield per hectare (Qt)

Table3. Mean values of yield and yield components of chickpea varieties combined over location

varieties	DTF	DTM	PHT	BRPP	PPP	SPP	HSW	YLDPHQ
Shasho	67.2^{a}	111.8^{b}	57.9^{a}	3.9^{ab}	59.9^{a}	1.4^{b}	26.0^{c}	19.8^{a}
Arerti	63.8^{b}	111.8^{b}	55.6^{a}	3.4^{b}	58.2^{a}	1.2^{bc}	28.7^{c}	20.1^{a}
Monino	62.7^{bc}	109.3^{c}	55.1^{a}	3.6^{b}	37.5^{a}	1.0^{c}	48.0^{a}	5.2^{c}
Harere	62.0^{c}	110.7^{bc}	54.5^{a}	4.4^{a}	61.2^{a}	1.1^{c}	26.8^{c}	15.9^{b}
Ejere	64.0^{b}	118.0^{a}	40.4^{b}	4.0^{ab}	83.6^{a}	1.9^{a}	36.0^{b}	13.7^{b}
Lsd(5%)	1.77	2.5	6.3	0.82	55.5	0.3	4.30	3.66
SE(m)	2.09	4.2	26.6	0.45	2054.4	0.06	12.12	8.96
Cv(%)	2.26	1.81	9.79	17.32	75.44	18.52	10.51	20.04

*Means with the same letter are not significantly different. DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BRPS =Number of primary branches per stand, PPP=pod per plant, SPP =Seed per pod, HSW =Hundred seed weight, YLDQ =yield per hectare (Qt)

Acknowledgment: We are thankful to Oromia Agricultural Research Institute (OARI) for funding the project "Adaptation trial of improved Kabuli chickpea varieties under agro ecology of western Oromia" during 2013/14.

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APPENDICES

Appendix 1. Mean square values of yield and yield components of chickpea varieties under Hawa Galan sub-site.

Source of variation	Degree of freedom	Mean square							
		DTF	DTM	PHT	BRPP	PPP	SPP	HSW	YLDPHQ
Replication	2	0.20^{ns}	2.40^{ns}	12.07^{ns}	0.35^{ns}	526.84^{ns}	0.05^{ns}	92.93^{ns}	40.11^{ns}
varieties	4	18.67***	35.07**	233.18**	0.63^{ns}	3698.40*	1.87**	2033.91**	350.22**
Error	8	0.62	3.07	28.04	0.38	164.19	0.06	21.70	7.90
Cv(%)	-	1.23	1.56	9.51	17.1	24.54	19.16	12.87	18.40

***= Very highly significant at P ≤ 0.001, ** = highly significant at P ≤ 0.01, *= significant at P ≤ 0.05, ns = not significant at P = 0.05, DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BRPS =Number of primary branches per stand, PPP=pod per plant, SPP =Seed per pod, HSW =Hundred seed weight, YLDQ =yield per hectare (Qt)

Appendix 2. Mean square values of yield and yield components of chickpea varieties under Tabor sub-site.

Source of variation	Degree of freedom	Mean square							
		DTF	DTM	PHT	BRPP	PPP	SPP	HSW	YLDPHQ
Replication	2	0.07 ^{ns}	2.07 ^{ns}	31.49 ^{ns}	0.24 ^{ns}	594.34 ^{ns}	0.010 ^{ns}	9.97 ^{ns}	15.43 ^{ns}
varieties	4	6.77 ^{ns}	33.23*	87.16 ^{ns}	0.48 ^{ns}	191.02 ^{ns}	0.38*	128.87***	137.42**
Error	8	3.57	5.23	25.19	0.51	683.48	0.058	2.53	10.03
Cv(%)	-	2.96	2.04	10.08	17.44	51.97	17.92	5.30	21.60

***= Very highly significant at P ≤ 0.001, ** = highly significant at P ≤ 0.01, *= significant at P ≤ 0.05, ns = not significant at P = 0.05, DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BRPS =Number of primary branches per stand, PPP=pod per plant, SPP =Seed per pod, HSW =Hundred seed weight, YLDQ =yield per hectare (Qt)

Appendix 3. Mean square values of yield and yield components of chickpea varieties combined over location.

Source of variation	Degree of freedom	Mean square							
		DTF	DTM	PHT	BRPP	PPP	SPP	HSW	YLDPHQ
location	1	0.13 ^{ns}	0.13 ^{ns}	259.31*	1.63 ^{ns}	1854.96 ^{ns}	0.04 ^{ns}	283.36**	2.82 ^{ns}
Replication	2	0.23 ^{ns}	4.43 ^{ns}	32.59 ^{ns}	0.11 ^{ns}	3908.04 ^{ns}	0.02 ^{ns}	49.72*	35.26*
varieties	4	23.72***	66.58***	293.81*	0.98 ^{ns}	1597.02 ^{ns}	0.76***	511.24***	221.59***
rep(loc)	2	0.03 ^{ns}	0.03 ^{ns}	10.97 ^{ns}	0.49 ^{ns}	4579.01 ^{ns}	0.01 ^{ns}	6.71 ^{ns}	0.22 ^{ns}
loc*variety	4	1.72	1.72	26.53	0.14	2752.0	0.09	126.10**	3.38
Error	16	2.10	4.15	26.61	0.45	2054.4	0.06	12.12	8.96
Cv(%)		2.26	1.81	9.79	17.32	75.44	18.52	10.51	20.04

***= Very highly significant at P ≤ 0.001, ** = highly significant at P ≤ 0.01, *= significant at P ≤ 0.05, ns = not significant at P = 0.05, DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BRPS =Number of primary branches per stand, PPP=pod per plant, SPP =Seed per pod, HSW =Hundred seed weight, YLDQ =yield per hectare (Qt)

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