

## Introduction of Desi Chickpea (*Cicer arietinum L.*) Varieties through Participatory Variety Selection: A Case for Konta and Tocha Districts in Southern Ethiopia

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Received date: December 14, 2017; Accepted date: January 02, 2018; Published date: January 09, 2018

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### Abstract

Chickpea (*Cicer arietinum L.*) is one of the most important pulse crops contributing a huge amount of protein to the human diet in Ethiopia. Though several improved varieties were released by research centers farmers still depend on low yielding indigenous crop varieties. Participatory variety selection is one of the methods used to evaluate varieties through involvement of users. The participatory chickpea variety selection was conducted during 2016/47 cropping season at Konta and Tocha districts. Six varieties were laid out in Randomized complete block design in three replications on model farmer field (grandmother trial) and single replication on farmer's field (mother trial). Grain yield and farmer selection data were collected and analysed. From all the tested varieties, variety Teketay was superior in grain yield (3204.3 kg ha<sup>-1</sup>) and (2449.9 kg ha<sup>-1</sup>) at Konta and Tocha, respectively. Whereas, the lowest grain yield was obtained from Kutaye (1533.1 kg ha<sup>-1</sup>) variety at Tocha and (510.5 kg ha<sup>-1</sup>) at Konta districts. In case of farmer preference Teketay score higher mean value (4.45) followed by Dalota (4.09) and least mean value was recorded from variety Kutaye (3.23). Therefore, the varieties Teketay, Dalota and Minjar selected by researcher and farmer data were recommended for production in these areas.

**Keywords:** Chickpea varieties; Crops; Farmers' preferences

### Introduction

Chickpea (*Cicer arietinum L.*) is the third most important pulse crop with a total annual global production of 9.7 million tons from 11.5 million ha. In Ethiopia, chickpea is mainly grown in the central, northern and eastern highland areas of the country at an altitude of 1400-2300 m.a.s.l., where annual rainfall ranges between 700 and 2000 mm [1]. It is the major cool season food legumes ranked second next to Faba bean, which occupies about 239,747.51 hectares of land annually with estimated production of 4,586,822.55 quintals. The national average seed yield is 1.913 ton/ha (CSA 2014/15) [2].

Chickpea, a multi-functional crop, has an important role in the diet of the Ethiopian small scale farmers' households and also serves as protein source for the rural poor who cannot afford to buy animal products [3-6]. Besides, due to its ability to withstand drought stress, smallholder farmers in Ethiopia grow chickpea at the end of the main rainy season using residual soil moisture. This permits farmers to grow a second crop and secure an additional source of income and protein through efficient use of the residual moisture in black soils at the end of the rains. Chickpea is valued for its nutritive seeds with high protein content, 25-28% after dulling. There are two main types of chickpea, distinguished by seed size, shape and color. The first relatively small seeds is called desi and with large seed called Kabuli. As a nutritious legume crop, chickpea has the potential to improve both soil health and human nutrition. Performing well on residual moisture, chickpea also allows farmers to harvest two crops in a growing season (cereal followed by chickpea), boosting their food supply and income (Figure 1).



**Figure 1:** Chickpea PVS evaluation field at Konta special woreda.

In Southern Nations, Nationalities and Peoples Regional State (SNNPRS), chick pea occupies about 5,662.23 hectares of land annually with estimated production of 9,389.28 tons (CSA, 2014/2015). Despite its importance the national (1.913 ton/ha) as well as regional average yields (1.658 ton/ha) of chickpea are low in Ethiopia due to different production problems including: low yield potential of landraces, lack of improved varieties, their susceptibility to biotic and abiotic stresses and poor cultural practices are some of the most serious production constraints in chickpea production in Ethiopia [4,7,8]. So far, the national and regional research institutions in the country have

released many varieties for commercial production. However, these varieties did not tested with full participation of farmers for their acceptance; adaptability potential under southern part of Ethiopia and did not reach the smallholder farmers living in the mentioned districts of Konta and Tocha districts (Figure 2). To overcome the above stated problems and to acquaint smallholder farmers with new technologies of widely grown chickpea crops production, the well-performed, adaptable and high yielding chickpea varieties were tested and identified. Therefore, the objectives of this study were to evaluate the performance of the released chickpea varieties through PVS and farmers preferred varieties by using grandmother and mother trials on farmers.

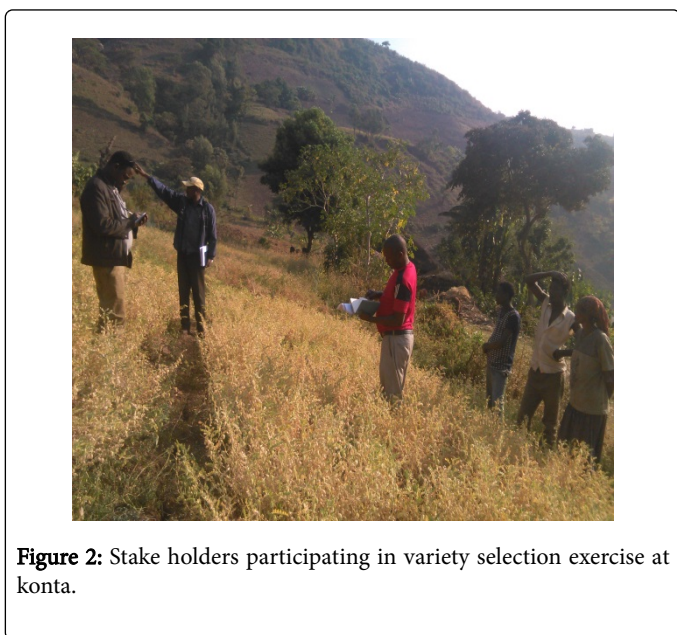


Figure 2: Stake holders participating in variety selection exercise at konta.

## Materials and Methods

Participatory varietal selection of chickpea trial was conducted in konta and Tocha Woredas of Southern Ethiopia, in 2016/17 Meher cropping season. The trial site of farmer in konta woreda of Oppa lashe kebele is located at 07007'523"N North latitude and 0360 41'808"E east longitudes at an altitude of 1,836 meters above sea level while the trial site. Tocha woreda of Wara hore kebele is located at 07, 10,082 N latitude, 037, 03,399 E longitude with an altitude of 1523 masl.

## Experimental design

Six chickpea varieties were assessed on-farm at Wara hore and Oppa lashe Kebeles in Tocha and Konta districts, respectively. The material for such trials was composed of six chickpea varieties (Table 1) were taken directly to farmer's field during 2016/2017. Randomized complete block design using six chickpea varieties with three replications on one model farmer's field was used for this research. This was named grandmother trial. Three other host farmers planted one replication each as mother trial. Both grandmother and mother trials were laid out in randomized block design with 3 replications. Each variety was grown with a plot size of 5.4 m<sup>2</sup> represented by 6 rows of 3 meter length with inter- and intra-row spacing of 30 cm and 10 cm, respectively. The grandmother trial was used to generate breeder's data while the three mother trials were used for participatory varietal selection and to value farmers' preferences during evaluation. The six

chickpea varieties were scored (1=bad/poor, 5=very good) based on over all ranks by consensus reached in representative farmers, and the mean values of the ranks for each variety were calculated.

No	Name of variety
1	Minjar
2	Natoli
3	Dalota
4	Mastwal
5	Kutaye
6	Teketay

Table 1: List of chickpea varieties tested.

## Results and Discussion

### Researchers' evaluation

Grain yield of grandmother trial: The analysis of variance (Tables 2-4) showed highly significant differences ( $P \leq 0.01$ ) among chickpea varieties for grain yield at Tocha and konta districts. The result of analysis of variance based on randomized complete block design experiment for Oppe lashe and Wara hore kebele grandmother trial on one farm presented in Table 2.

In the study, the yield performance of Teketay, Dalota and Minjar were superior to grand mean and other varieties tested in the district and there were highly significant differences among the test varieties in grain yield performance (Tables 2 and 3). Grain yield ranged from 2449.4 kg ha<sup>-1</sup> (Teketay) to 1553.1 kgha<sup>-1</sup>(Kutaye) with the grand mean of 2099.77 kg ha<sup>-1</sup>. Teketay, Dalota and Minjar were the superior yielding while Kutaye was relatively the lowest yielding varieties. Similarly, at konta the yield performance of Teketay, Dalota and Minjar were superior to grand mean and other varieties tested in the district and there were highly significant differences among the test varieties in grain yield performance (Tables 2 and 4). As woreda agricultural expert explained chickpea production is not common and new introduction to the vicinity. Hence, the PVS result clearly showed that at both districts the high yielding varieties such as Tekatay, Dalota and Minjar could be best varieties of chickpea alternatives than other pulse crops and can be introduced in study areas and similar agro ecology in seed production and distribution.

Varieties	Tocha district			Konta district			Combined		
	GY	PI	R	GY	PI	R	GY	PI	R
Minjar	2302.5ab	9.6	3	2741.4ab	15.74	3	2522.0ab	12.9	3
Natoli	2064.2ab	-	4	2724.7ab	15.03	4	2394.5ab	7.2	4
Dalota	2350.6a	11.95	2	2964.2a	25.14	2	2657.4a	18.9	2
Mastwal	1875.3bc	-	5	2066.7b	-	5	1971.0b	-	5
Kutaye	1553.1c	-	6	510.5c	-	6	1031.8c	-	6
Teketay	2449.4a	16.65	1	3204.3a	35.3	1	2826.9a	26.5	1
G. Mean	2099.77	-		2368.62	-		2234.2		

LSD (5%)	438.83		885.66		662.2	
CV (5%)	11.49		20.55		16.0	

**Table 2:** Mean values of grain yield (kg/ha) of chickpea varieties at two locations. \*Means with the same letter are not significantly different. Where Gy: Grain Yield, PI: Percentage Increase and R-rank.

Source of variation	Mean square
	Grain yield (kg/ha)
Rep	1015.844
Varieties	346049.707**
Error	58184.325
CV (%)	11.49

**Table 3:** Analysis of variance for grain yield (kg) of chickpea grandmother trails at Tocha. \*\*=highly significant at  $P \leq 0.01$ , \*=significant at  $P \leq 0.05$ , ns=not significant at  $P=0.05$ .

Source of variation	Mean square
	Grain yield (kg/ha)
Rep	96102.20
Varieties	2917582.92
Error	236998.14
CV (%)	20.553

**Table 4:** Analysis of variance for grain yield (kg) of chickpea grandmother trails at konta. \*\*=highly significant at  $P \leq 0.01$ , \*=significant at  $P \leq 0.05$ , ns=not significant at  $P=0.05$ .

Selection Criteria set by farmers	Chickpea varieties					
	Mastwal	Natoli	Minijar	Teketay	Dalota	Kutaye
Tocha district						
Branch number	2	1	4	5	3	2
Vigourity	2	5	1	3	4	2
Plant height	4	5	4	2	3	4
Seed size	4	5	5	5	3	1
Pod number	4	5	4	5	5	4
Earliness/maturity	5	5	3	5	4	5
Drought resistance	1	5	3	5	4	1
Pest resistance	4	1	4	5	3	4
Suitability for intercropping	4	5	3	4	4	4
Straw yield	5	4	2	5	4	5

### Farmers' variety evaluation and criteria

Chickpea variety selection was carried out at flowering and maturity stages by organizing a field day /visit. Farmers' selection criteria were number of branch, early maturity, pod and seed size, pest resistance, seed colour and yield. Out of the eight different traits, farmers chose traits that they often use when evaluating chickpea genotypes for adoption. Therefore, while farmers consider many traits, there are a few traits that they often use and these need to be identified. Past studies by Kamara et al. [6] working on cowpea, [2,3] working on common beans and [9] working on faba bean reported similar findings of farmers using a combination of a few traits when evaluating new genotypes. There were 41 participants at Tocha and konta districts during chickpea variety selection. The 41 participants were comprised of 28 Male and 13 Female for participatory variety selection (PVS) evaluation at both districts. Finally selection of chickpea variety/ies was done by the farmers based on their preference criteria.

At Tocha and konta chickpea varieties Teketay, Natoli, Dalota and Minijar were preferred for seed size, early maturity and good seed color and high yield, respectively (Table 4). For this purpose farmers rank the varieties as very good, good, average, poor and very poor using 1-5 scale. Where "5" means very good,"4" means good "3" means average "2" means bad and "1" means worst. Finally the farmers should select the varieties to use them as planting material as first, second, third and fourth preferred variety. Accordingly chickpea varieties Teketay, Dalota, Natoli, and Minijar were selected by the farmers.

Finally the participant farmers selected and accepted Teketay, Dalota, Minjar and Natoli as best varieties at both test district in order of preferences (Table 5). Farmers and respective woreda Agriculture and natural resource development office were expert request the seed of selected varieties to promoted or multiply in future. Therefore, the participant farmers and districts head decided to expand the selected improved chickpea varieties on their farm.

Yield	4	4	5	5	5	4
Konta district						
Branch number	2	3	4	5	4	2
Vigourity	2	4	1	3	5	2
Plant height	4	3	4	2	5	4
Seed size	1	3	5	5	5	2
Pod number	4	5	4	5	5	2
Earliness/maturity	5	4	3	5	5	5
Drought resistance	1	4	3	5	5	1
Pest resistance	4	3	4	5	1	4
Suitability for intercropping	4	4	3	4	5	4
Straw yield	5	4	2	5	4	5
Yield	4	5	5	5	4	4
Sum	75	87	76	98	90	71
Average	3.41	3.95	3.45	4.45	4.09	3.23
Rank	5	3	4	1	2	6

**Table 5:** PVS of Desi chickpea based on farmers selection criteria n=41 (M=28; F=13 at two districts. NB: "5" means very good and "1" means very poor.

## Conclusion

Participatory varietal selection is the selection by which farmers evaluate finished or near finished products from plant breeding programs on their own farms. The present study at Tocha and Konta entail the presence of significant variations among desi chickpea varieties. Analysis of variance of the individual location result of both Tocha and Konta indicated that varieties Teketay, Dalota and Natoli are the four best varieties for the test agro ecology. In this trial the rank given by researchers match with farmers rank. That means most of the studied varieties selected by farmers' based on their own selection criteria and researcher analysis had the same result. Thus, these varieties are found to be well adapted and promising to the two target districts in both the researcher's and farmers will be demonstrated and popularized to the small-scale holder farmers. Therefore, Researcher data analysis and farmers' varietal selection criteria should be taken into consideration proper varietal recommendation.

## Recommendations

For results from this preliminary study to transform in to improved food and income security, we need to carry out:

- Promotion of three chickpea varieties in chickpea trial areas.
- Development of seed multiplication and dissemination protocol to make seeds of four varieties sustainability accessible to farmers.
- Promotion of good agricultural practices in chickpea production.

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