

On Farm Demonstration and Evaluation of Improved Chickpea Varieties at Adola Rede, Guji Zone, Southern Oromia, Ethiopia

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Abstract

Chickpea is important as food and feed crop for farmers. The crop is also significant for generating income. However, production of chickpea at Adola Rede district was not known due to absence of improved seed. Thus, this study was instigated to demonstrate new varieties of chickpea to farmers. Six experimental farmers were selected and sown at seed rate of 100kg/ha of Dalota and Habru variety on the area of 100m² with 60kg/ha of NPS fertilizer. Training on agronomic practices and recommended packages of fertilizer and seed were given for selected farmers, Development Agents and Subject Matter Specialists. Field day was arranged in order to create demand and popularize chickpea in the study area. The yield performance of chickpea showed that Dalota gave 18.83qt/ha while Habru variety was 14.23 qt/ha. Demonstration of chickpea at Adola Rede was profitable since net farm income of Dalota and Habru was 28897 ETB/ha and 20872 ETB/ha respectively. The most important chickpea trait preferred by farmers' was disease and insect tolerant. Dalota was more preferred by farmers due to its disease and insect tolerant, more yielder and higher in number of pod per plant. Thus, Dalota should be scaled up to many farmers. Therefore, it is important that Bore Agricultural Research Center should adapt new variety with trait that farmers preferred.

Keywords: Chickpea; Dalota; Habru; Demonstration; Evaluation; Farmers' preference

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Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crops grown in Ethiopia because of its multiple functions. It is a key component of the daily diet, and thus important protein source for Ethiopian households who cannot afford animal products. Recently, the studies of Megersa., *et al.* (2018) and Bereket and Abdirazak (2018) also stated that chickpea has a great economic merit in Ethiopia providing a cheap source of protein for human diet and animal feed, and as a source of alternative cash income to the farmers and foreign currency to the country.

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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 (Yasin and Genene, 2018; Endalkachew, *et al.* 2018). Chickpea improves the soil N status as a result it reduces the cost of farmers for N fertilizer for subsequent crop production (Tena, *et al.* 2016).

Chickpea is a less labor-intensive crop and its production demands low external inputs compared to cereals. The total land coverage and yield of chickpea in Ethiopia are estimated to be 225607.53 hectares and 444145.93 tons, respectively (CSA, 2017). Despite its nutritional values, high economic importance, the national average yield of chickpea is still lower (1.97 t/ha; CSA, 2017) than its potential

Chickpea is until now not under production in the potential areas of Guji zone (Deres, *et al.* 2018). Among Guji Zone districts Adola Rede district was potential for production of chickpea. But Adola Rede farmers had no experience on chickpea production. Thus, we proposed on farm demonstration and evaluation of chickpea research activity on farmers land in order to (1) evaluate the productivity and profitability of improved chickpea under farmers' management (2) to assess farmers' preference criteria on improved chickpea varieties.

Materials and Methods

Description of study area

Adola Rede district is 468KM away from the Addis Ababa to the South. The district is bordered by Ana Sora district in the North, Wadera district in the South and Odo Shakiso in the West and Girja district in the East directions. The district has altitude range of 1350-2340 meter above sea level, annual mean of 1000mm rainfall and annual average of 28°C of temperature. Mixed farming, mining and forest product production are the major livelihood of Adola Rede farmers. Adola district has diverse agro-ecologies which are suitable for production of different crops. The rainfall pattern of the district is bimodal for lowland and midland areas and uni-modal for highland parts. Sandy, clay and silt are the major soils of Adola Rede district. The major crops produced in the area includes maize, tef, haricot bean, chat, coffee and the others. The black soil characteristics of the area make it potential for production of chickpea.

Sample Size and Research design

Based on the area convenient for monitoring and evaluation purpose and potential production of chickpea two Kebeles were purposively selected. The activity was conducted in Gobicha and Dole Kebeles in 2017 and 2018 cropping season. From each kebele 15 farmers were selected and grouped as one Farmers Research Group. Farmers Research Group conducted demonstration of chickpea at three experimental farmers in their respective Kebeles. That mean for the two varieties of chickpea (Dalota and Habru) there were six replication on farmers land. However, we do not used local variety in our demonstration experiment since there was no local variety and chickpea production is new farming in the study area.

Two improved chickpea varieties namely Dalota and Habru were used for demonstration on six replicated areas in the selected kebeles. The experiment was planted on single block design 10m x 10m plot size by row planting methods, ten (10) cm between plant and forty (40) cm between rows. For demonstration of chickpea varieties, the recommended 100Kg/ha seed rate was used with 60kg/ha of NPS fertilizer.

Method of Data Collection and Analysis

Observation, measurement and face to face interview was employed to collect the data. The collected data were analyzed by t-test, mean, matrix ranking and net farm income.

Results and Discussion

Capacity building on chickpea production

Having knowledge is important to undertake any agricultural production. Thus, knowledge refers actual measurable that a farmer needs to learn in the production of chickpea. In order to capacitate the farmers' knowledge on chickpea trainings were given for

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selected Farmers Research Group members, Development Agents (DAs), and Subject Matter Specialists (SMSs). Training topics covers the recommended packages of chickpea for the area and agronomic practice of chickpea production methods which was given by Biological Researchers while the importance and approach of farmers' research group for sustainability of the experiment was given by agricultural extension researchers. Exchange visit and field days were organized to enhance farmer to farmer learning and to publicize chickpea for many farmers. In general, these capacity buildings created demand on chickpea production. Therefore, trainings, exchange visit and field days made farmers to produce chickpea as many farmers eager to produce chickpea on their farm. Table 1 shows number of farmers who capacitated in knowledge during demonstration of chickpea.

Capacity building methods	Participants	Number of participant during 2017 production season			Number of participant during 2018 production season		
		Male	Female	Total	Male	Female	Total
A. Trainings	Farmers	80	25	105	46	14	60
	DAs	2	1	3	3	2	5
	SMSs	6	1	7	5	1	6
B. Field days	Farmers	114	18	132	49	7	56
	DAs	13	5	18	4	2	6
	SMSs	8	4	12	5	2	7
	Others	23	7	30	10	3	13

Table 1: Capacity building methods and number of participant for demonstration of chickpea.

Yield, seed and pod performance of chickpea demonstration

Among the demonstrated varieties Dalota was yielder per hectare (18.83 quintal/ha) than Habru variety (14.25 quintal/ha). 1quintal = 100kg. The yield result of this demonstration was lower than the result of adaptation which was 23 and 19 quintal/ha for Dalota and Habru respectively (Deres., *et al.* 2018). During 2017 production season there was frost during flowering of chickpea. And also, there were high infestation of pod borer during pod settings. These made the yield of chickpea demonstration less. Dalota variety had high number of pod per plant (88) than Habru variety (83). Moreover Dalota had more seed per pod (1.43) than Habru.

Variety	Parameters	N	Minimum	Maximum	Mean	Std. Deviation
Dalota	Pod per plant	6	76	117	88.96	14.567
	Seed per pod	6	1	2	1.43	.400
	Yield (quintal/ha)	6	16	22	18.83	2.041
Habru	Pod per plant	6	62	116	83.67	18.228
	Seed per pod	6	1	1	1.00	.000
	Yield (quintal/ha)	6	12	16	14.25	1.332

Table 2: Yield, seed and pod performance of chickpea demonstration.

Independent t test was used to explain the mean difference between chickpea variety. If the significance value for the Levene test is high (greater than 0.05), use the results that assume equal variances. Otherwise, use the results that do not assume equal variances. In this study, the equal variances are assumed ($p = .362 > .05$). A significance value of .001 (less than .05) indicates that there was a significant difference mean yield between Dalota and Habru. In addition, since the confidence interval for the mean difference did not contains zero within its range this also indicated that the mean yield difference was significant. Based on the results of independent t-test ($p = .001 < .05$), it was concluded that there was significant difference in yield between Dalota and Habru variety in the study area (Table 3).

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Yield per hectare	Equal variances assumed	.914	.362	4.606	10	.001	4.58	.995	2.36	6.80
	Equal variances not assumed			4.606	8.606	.001	4.58	.995	2.31	6.85

Table 3: Result of Independent Samples Test.

Profitability of chickpea

Production costs and returns of demonstration of chickpea was collected from experimental farmers. Production costs included were variable and fixed costs. Variables costs include cost of land preparation, cost of seeds, cost of fertilizers, planting, weeding, harvesting, cost of transport and cost of sacks. Fixed cost was cost of land. In Adola Rede area chickpea was planted after maize or haricot bean harvested. Thus, cost of land (2000 ETB) was included for one season of production. Average farm gate price was 21.42ETB/kg and 20.67ETB/kg for Habru and Dalota variety respectively. On farm demonstration of chickpea at Adola Rede district was profitable for farmers with return of 28897 ETB/ha and 20872 ETB/ha for Dalota and Habru variety respectively (Table 4). Even though Habru had high farm gate price during demonstration the profitability of Habru was lower than Dalota since Dalota had high return per hectare than Habru.

	Dalota variety		Habru variety	
	Mean	Std. Dev.	Mean	Std. Dev.
Yield per hectare in quintals (100Kg = 1quintal)	18.83	2.041	14.25	1.332
Farm gate price of chickpea at Adola Rede in ETB	20.67	1.402	21.42	1.686
Cost of land in ETB	2000.00	.000	2000.00	.000
Cost of 100kg seed	3400.00	.000	3400.00	.000
Cost of 60kg fertilizer	609.25	8.02	609.25	8.02
Cost of land preparation and sowing	972.50	176.5	972.50	176.5
Cost of weeding	1342.17	156.5	1342.17	156.5
Cost of harvesting	868.83	76.60	868.83	76.60
Cost of threshing	537.58	47.37	537.58	47.37
Other costs (lunch, transport, sacks...)	97.17	4.02	97.17	4.02
Total fixed cost (cost of land)	2000.00	.000	2000.00	.000
Total variable costs (all cost except cost of land)	7827.67	194.9	7827.67	194.9
Total cost (TFC+TVC)	9788.67	215.9	9788.67	215.9
Total Revenue =yield per hectare in kg x farm gate price	38445.0	2995.1	30700.0	2627.5
Gross Margin= Total Revenue - Total Variable cost	30897.3	2601.5	22872.3	2616.3
Profitability = Gross margin - Fixed Cost	28897.3	2601.6	20872.3	2616.3

Table 4: Profitability analysis.

Farmers’ preference on chickpea varieties

The preference of a variety and its traits by farmers depends on their importance to farmers’ farming. Thus, yield per hectare, market demand, disease and insect reaction, early maturity and number of pod per plant were some of chickpea traits identified and used to evaluate chickpea varieties by the selected farmers in the study area. During varietal selection, the 6 Farmers Research Group members (16 in number) and three non FRG members with a total of 19 household heads (male = 15 and female = 4) were participated. Evaluation was conducted before and after harvesting. In pair wise ranking method, each trait was compared with the other traits. The number of time a trait had been found to be more important was measured by counting the number of times trait number appeared in the matrix. The trait number to appear most times said to be the most important trait. In this study trait “disease and insect reaction” appears more times (four times) in the matrix than any other traits. Therefore, disease and insect resistant trait was considered to be the most trait preferred by farmers (Table 5).

Preference criteria	Yield per hectare	Market demand	Early maturity	Disease & insect reaction	Number of pod/plant	Total score	Rank
Yield per hectare						2	3
Market demand	Market demand					3	2
Early maturity	Yield per hectare	Market demand				0	5
Disease & insect reaction	Disease & insect reaction	Disease & insect reaction	Disease & insect reaction			4	1
Number of pod/plant	Yield per hectare	Market demand	Number of pod/plant	Disease & insect reaction		1	4

Table 5: Pairwise ranking of farmers’ (n = 19) selection traits for chickpea varieties.

Dalota variety gave yielder than Habru variety. Dalota had more disease and insect tolerant than Habru. Based on number of pod per plant Dalota variety was preferred by farmers. The preference of Habru over Dalota variety was due to its high market demand (Table 6). During variety selection, farmers Research Group mentioned that Habru variety was susceptible for peoples walking around Habru farm due to people uprooting Habru for its green mature seed consumption.

Selection criteria	Yield per hectare	Market demand	Early maturity	Disease & insect reaction	Number of pod per plant	Total score	Rank
Relative weight	3	4	1	5	2	-	-
Dalota	15 (5)	12 (3)	1 (1)	20 (4)	8 (4)	56	1
Habru	9 (3)	20 (5)	1 (1)	10 (2)	6 (3)	46	2

Table 6: Direct matrix ranking of chickpea varieties by farmers (n = 19).

Note. Numbers in the bracket indicated the performance rating value of each variety given from 1-5 (5 = excellent, 4 = very good, 3 = good, 2 = poor and 1 = very poor) and numbers written in the bold indicate total score of a variety as per each selection criteria, which was obtained by multiplying the relative weight of each selection criteria with that of the performance rating number in the parenthesis. The relative weight criteria (5 = the most important, 4 =very important, 3 = important, 2 = somewhat important, 1 = little important).

Conclusion and Recommendation

On farm demonstration and evaluation chickpea was conducted at Adola Rede district in order to evaluate yield and profitability under farmers' circumstance. Dalota and Habru chickpea variety was demonstrated on farmers land. Training, exchange visit and field days were effective in capacitating farmers' knowledge on chickpea production. The mean yield of Dalota and Habru demonstrated was 18.83 Qt/ha and 14.25 Qt/ha respectively. The result of yield demonstration was lower than the adaption result due to frost and infestation of pod borer during flowering and pod stages. However, on farm demonstration of chickpea was profitable at Adola Rede. The preference of a variety and its traits depends on their importance to farmers farming. In this study yield per hectare, market demand, disease and insect reaction, early maturity and number of pod per plant were some of chickpea traits identified by farmers and used to evaluate chickpea varieties by the selected farmers in the study area. The result of matrix ranking revealed that disease and insect resistant chickpea trait was the most trait preferred by farmers in study area. That is why Dalota variety was more preferred by farmers due to its disease and insect resistant ability. For farmers each variety has its own advantage over the other. Despite in low yield and low disease resistance Habru was preferred by the farmers for its high market demand. Since Dalota had high disease and insect tolerant, high yield, high in number of pod per plant and generate more return it should be scaled up to many farmers. In Adola Rede, the most expected from chickpea variety was disease and insect resistant variety. Therefore, Agricultural Research should adapt new variety with trait that farmers preferred.

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