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Pre-Extension Demonstration of improved Chickpea varieties with their production packages in South West Shea Zone of Oromia Regional Estate, Ethiopia

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Abstract

Demonstration of improved chickpea varieties with their production package were conducted in south west Shewa zone of Oromia Region at Kesa Malima and Sebeta Hawas districts for two consecutive years (2016/17 and 2017/18). This study was carried out to demonstrate the performance of chickpea varieties under farmers' field conditions, to exchange experiences and get feedbacks from farmers and other stakeholders in the study area. The trial was executed on 21 host farmers' fields using two released chickpea varieties of Habru and Natoli including farmer's local variety. Grain yield, farmers' perception data and feedback were collected from the demonstration plots. Simple descriptive statistics was used to analyze the collected data. The simple statistical data analysis result indicates that the improved varieties gave better yield than the local check variety in Sebeta Hawas. Mean grain yield across location showed that improved varieties of Natoli and Habru have 21.66. qt/ha and 24.15 qt/ha that is higher than the local variety mean of 14.5 qt/ha. An overall yield advantage and yield increase of Natoli and Habru varieties over local were 8.41 qt/ha and 36.71% respectively. Farmer's preference result showed that variety Habru ranked first followed by Natoli. Habru variety was highly preferred by the evaluators due to its various merits like, disease resistance, marketability, seed size and seed color.

Key words: Demonstration, chickpea, variety

Introduction

Chickpea (*Cicerarietinum*L.) is an important grain legume cultivated by Smallholder farmers in Ethiopia. Chickpea is widely grown in different agro-ecological zones i.e. between 1400 to 2300 mater above sea level where the mean annual rain fall ranges from 700-2000 mm (Geletu Bejiga

and Million Eshete, 1966). It provides an alternative source of protein, energy, minerals, and cash income for the smallholder farmers (Tufa B. and Abdela A., 2018). In addition, it serves as a source of animal feed. Inclusion of chickpea in crop rotation helps in improving and maintaining soil fertility of the cereal-dominated farming systems of the country. Currently, chickpea is cultivated in four regions of the country, Amhara, Oromia, Southern Nations, Nationalities and people's (SNNPR) and Tigray. The major chickpea producing regions in Ethiopia are Amhara and Oromia, together produce 92.58% of total chickpea production in Ethiopia while SNNPR and Tigray 4.33% and 2.89% respectively (CSA2016/17). Chickpea area coverage and productivity in Ethiopia have been increasing over a period of time. These clearly show the importance of the crop in the country as well as the utilization of improved technology by the farming community.

The mean area of chickpea under cultivation in Oromia region during 2016/17 was 81,286.46 ha, constituting 1.42% of the total cultivated area in the country. Particularly chickpea covers 13.32% of the total pulse cover in the region. Chickpea has tremendous opportunities for its production like; high policy support, higher market price, and increased consumption by farm households and a number of improved chickpea high yielding varieties have been released by both national and regional research centers. However, its production in the region as well as in the particular study area does not exceed 2.5 t ha^{-1}. This is because the farmers us low yielding, traditional practices coupled with disease and insect pest problems (Goa Y. and Ashamo M., 2016). Therefore, demonstration of newly released varieties with their production package is important in order to bring impact and enable farmers get advantage of the varieties. Chickpea varieties, Habru and Natoli were released in 2004 & 2007, r espectively, by Debre Zeit Agricultural Research Center, but these varieties were not used by farmers in the study areas. These two varieties are assumed to have good yield and adaptability in the study area. However, demonstration of these varieties with their production package is not done widely in order to popularize the varieties in the area. Hence, this study was made in order to demonstrate improved chickpea varieties with their production package to the farming community and assess farmers' feedback with the following objectives.

- To demonstrate the potential of new chickpea varieties and associated management technologies to farmers and extension agents in the study area
- To acquaint the end users with the knowledge and practice of using recommended full packages of chickpea technologies through field trainings and discussions

- To exchange experience among farmers and assess farmers' reaction towards the new chickpea technologies for further promotion and improvement

Materials and methods

Description of the study area:

The research was conducted in Kersa Malima and Sebeta Awas districts of Oromia Regional state of Ethiopia.

Kersa Malima: Geographically the woreda is located between latitudes of 8.360 N to 8.710 N and with longitudes of 38.340 E to 38.710 E. The woreda is located at 60 Km south west of Addis Ababa with the total area of 58613 hectare (586 Km2). Elevation varies from 1839 to 3568m a.s.l. It is bounded with S.N.N.P. national regional state to the south west, East Shewa Zone to the east, Sodo Dachi, Alemgena, and Tole Woredas to the south, north east and North West, respectively. The study area is characterized by tropical and warm too cold humid temperate climates. These areas are characterized by an average temperature that ranges from 10-19 0C and the rainfall that ranges from 974-1319 mm. The highland part of the woreda is characterized by; moderate an average temperature 10-15 0C and 1170-1319 mm rainfall. The vegetation type in the woreda is juniperous forest, podocarpus, sub afro alpine region with discontinuous canopy and larger trees limited in spatial cover (KMWBoA, 2014)

The farming system in the district is mixed crop-livestock type, whereby crops contribute larger share to farmers' income. As of potentialities, the district has high potential for crop production. The five major crops grown in the area are wheat, teff, barley, faba bean and chick pea. In 2014/15 cropping season, about 31.25% of crop land was covered by wheat, 19.79% by teff, 18.47% by barley, 10.19% by faba bean and 6.30% by chickpea of the cultivated area (KMWBoA, 2014). Kersa Malima is a potential faba bean producing district where, faba bean production is about 22.77 quintal per ha is greater than the national average, which is the highest next to Arsi zone in Oromia region

Sebeta Hawas District: Sebeta Hawas is the second District of the study area which is found in Oromiya Special Zone around finfine, Oromia Region which is located at a distance of 24 km to 45 km south west of the capital Addis Ababa and between 8° 44' 59.99" N latitude and 38° 39' 59.99" E longitude respectively. The district has an area of 87,532 ha. It has shares borders with Akaki district in the east, Kersa and Tole district in the south, Wolmera district in the northand

Ilu and Ejere districts in the west. The land feature of Sebeta Hwas is characterized by mountains and hills and marshy plains and is surrounded by Awash water shade in the west. The altitude in the district ranges between 1800 and 3385 masl (Sebeta Hawas District Rural and Agricultural Office, unpublished data of 2017). The district has 36 rural and 4 town kebeles; the total number of population accounts 162,852 out of this 83,528 male and 79,324 female (SHDRAO, 2017).

Agricultural activity is the dominant means of livelihood in the district. According to annual report of Sebeta Hawas District Rural and Agricultural Office, out of 87, 532 ha of land 73, 838 ha (84%) are used for agriculture to cultivate different crops for household consumption and sale in local market, and 3,689 (4.2%) of land is used as grazing area (SHDRAO, unpublished data 2017). The district is divided into two agro-ecological zones i.e. highland (12%) and mid land (88%) areas respectively. The major crops grown in the districts are cereals, highland pulses and vegetables. Based on woreda level crop production ranking of Ethiopia, Sebeta Hawas is third in chickpea, tenth in teff and 18th in wheat production (IFPRI-REAP 2015).

Site and farmers' selection

Site selection

As a targeted area, one district from south west Shewa zone of Oromia region and one district from Finifine special zone of Oromia were selected for the implementation of the demonstration activities due to their potential for chickpea production and the high demand of the crop in the area. The districts were Sebeta Awas and Kersa Malima. Selections of kepeles were carried out in collaboration with district agricultural experts and kebele development agents. Accordingly, three kebekes from each district were selected as demonstration sites for demonstrating the varieties based on accessibility and potential of the crop.

Farmers' selection

Having suitable and sufficient land to conduct the demonstration activity, willingness to contribute land and labor, vicinity to road so as to facilitate of being visited by many farmers, initiative to implement this activity according to recommended packages, good field management practice and willingness to share the technologies to others were criteria used to select the participant farmers. Accordingly, 25 host farmers from six kebeles were selected for demonstrating the improved technologies.

Experimental design

Two improved chickpea varieties (Habru and Natoli with one local check) were used for conducting the demonstration activity by using each farmer's field as a replication. The varieties were planted on the second week of August at Kersa Malima and the beginning of September at Sebeta Awas with a plot size of 500 m^2 and a seed rate of 140 kg ha^{-1}. DAP fertilizer at rate of 100 kg ha^{-1} and bio-fertilizer at rate of 500 gm. ha^{-1} was applied during planting time with full recommended management packages. Row planting method was employed and spacing between rows and plants was 30 cm and 5cm respectively. The trial was weeded twice i.e. first 30 days after planting and second six weeks after planting of the varieties. Farm operation activities like land preparation-plowing two to three times using oxen plough, planting, first and second hand weeding, harvesting and threshing were held by the host farmers. HARC supplied only the recommended amount of seed and fertilizer. To control African ball worm insect the recommended chemical endosalufan 35% EC two liters per hectare was applied.

Technology observation and evaluation approaches

The demonstrated technologies were promoted to host and follower farmers using different extension technics, such as trainings, field visit and observation, experience sharing and field days.

Training

Theoretical as well as field practical training is very crucial to create awareness and improve the knowledge, skill and attitude of farmers, DAs and agricultural experts. Hence, farmers, development agents and agricultural experts from two districts were participated in the training program. The topics of Field practical training were on chickpea crop production and management practices, field follow up, data collection and handling and post-harvest handling. In this training program about 105 farmers, development agents and agricultural experts were participated.

Field day

A field day was also organized at Kersa Malima district to evaluate the overall successes, challenges and performance of the demonstration plots by involving different participants. During this event invited guests from zone agricultural bureau, district level agricultural experts, development agents, farmers and researchers were participated. In this event, about 175

individuals (100 farmers, 30 development agents, 20 zone and district level agricultural experts and 25 researchers were attended. From the total participants 25% of them were female and the rest were male. In this field day:

- Improved chickpea technologies were introduce to surrounding farmers, agricultural experts and development agents
- participants share experience and good farming practices and engage in discussion to learn from each other
- Linkage between research, BoA, farmers and different stakeholders was strengthening.
- feedback about the performance of technologies was collected

Data collection: quantitative and qualitative data like yield data, farmers opinions, ideas, perceptions, interest and views were collected.

Summary of Results

Combined over the two years (2016 and 2017), the yield performances of the tested varieties at the two districts (Sebeta Hawas and Kersa Malima) is indicated in Table below. At Sebeta Hawas, the two years mean grain yield of variety Natoli ranged from 15.5 to 23.6 qt/ha with a mean of 19.82 qt/ha. This variety gave a yield advantage of 3.79 qt/ha and a yield increase of 16.14% over the national average yield of chickpea. When we compare the mean yield of improved variety with farmer's local variety, there was a yield advantage of 5.35 qts/ha and a percent yield increase of 26.84. On the other hand variety Habru gave a mean grain yield of 24.8 qt/ha with a yield advantage and yield increase of 4.04 qt/ha and 16.77% over the national average yield of chickpea in the country. The result in the table also revealed that variety Habru has 9.68 qt/ha yield advantage and 40.03% yield increase over farmer's local variety (Table 1-3).

In the same season at Kersa Malima district, the mean yield result of 2016/17 season of variety Natoli 23.48 qt/ha, while that of Habru gave a mean yield of 22.3 qt/ ha with a yield range of 21.0 to 26.75 qt/ ha respectively. When we compare the national average yield 20.14 qt/ha of chickpea with the improved variety of Habru, there was 3.56 yield advantage and 15.02% yield increase (Table 4&5). The yield data in the table showed that there was an overall yield advantage and percent yield increase of 2.77 qt/ha and 12.09% improved chickpea variety across location over the national average yield of chickpea in the country (Table 6). In this district

farmers did not use the local variety seed for production; they normally grow the improved variety of chickpea. In this district, during 2017 cropping season, the demonstrated variety Natoli was totally devastated by Ascochyta blight disease and no yield was harvested. Early planting, early onset and high rainfall during the production season created conducive environment for the severity of the disease. This indicated that though the mean yield performance of Natoli was higher than that of Habru during the disease free season, this variety should be grown only in Ascochyta blight disease free areas or seasons. However, variety Habru performed well even under the presence of disease pressure. Therefore, Habru and similar varieties with the disease tolerance/resistance should be recommended for this area and similar agro-ecology in the country.

Table 1. Grain yield qt/ha of improved chickpea variety and farmers local variety at Sebeta Awas district, 2016/17-2017/18 cropping season.

Farmer	Grain yield qt/ha of variety Habru			Grain yield qt/ha of variety Natoli			Grain yield qt/ha of variety local		
	2016/17	2017/18	Mean of two years	2016/17	2017/18	Mean of two years	2016/17	2017/18	Mean of two years
F1	21.5	21.5	21.5	25.5	5.5	15.55	9.2	10.0	9.6
F2	23.5	24.4	23.95	23.0	19.6	21.3	15.5	16.4	15.95
F3	22.0	27.0	24.5	27.0	6.5	16.75	13.5	15.2	14.35
F4	23.0	25.0	24.0	21.0	20.08	20.54	12.0	16.0	14.0
F5	21.5	23.2	23.85	20.5	22.0	21.25	11.6	16.0	13.8
F6	-	24.0	24.0	-	23.6	23.6	-	17.2	17.2
Mean	**22.9**	**24.18**	**23.63**	**23.4**	**16.33**	**19.82**	**12.36**	**15.13**	**14.5**

Table 2. Yield advantage and percent yield increase of improved chickpea variety over local variety at Sebeta Awas, 2016/17and 2017/18 cropping season.

Farmer	Mean of two years for var. Habru	local ave. yield of 2016 & 2017	Yield adv. over local variety	% yield increase over local variety	mean of two years for var. Natoli	local ave. yield of 2016 &2017	Yield adv. over local	% yield increase over loc
F1	21.50	9.6	11.9	55.35	15.55	9.6	5.95	38.26
F2	23.95	15.95	8.0	33.40	21.3	15.95	5.35	25.12
F3	24.50	14.35	10.15	41.43	16.75	14.35	2.40	14.33
F4	24.50	14.0	10.5	42.86	20.54	14.0	6.54	31.84
F5	23.85	13.8	10.05	42.14	21.25	13.8	7.45	35.06
F6	**24.0**	17.2	6.8	28.33	23.6	17.2	6.40	27.12
Mean	**24.18**	**14.5**	9.68	40.03	**19.82**	**14.5**	5.32	26.84

Table 3. Yield advantage and percent yield increase of improved chickpea variety over national average yield qt/ha at Sebeta Awas, 2016/17and 2017/18 cropping season.

Farmer	Mean of two years for var. Habru	National ave. yield of 2016 & 2017	Yield adv. over national	% yield increase over national	mean of two years for var. Natoli	National average yield	Yield adv.	% yield increase
F1	21.50	20.14	1.36	6.33	15.55	20.14	-4.59	-29.52
F2	23.95	20.14	3.81	15.91	21.3	20.14	1.16	5.45
F3	24.50	20.14	4.36	17.80	16.75	20.14	-3.39	-20.24
F4	24.50	20.14	4.36	17.80	20.54	20.14	0.4	1.95
F5	23.85	20.14	3.71	15.56	21.25	20.14	1.11	5.22
F	**24.0**	20.14	3.86	16.08	23.6	20.14	3.46	14.66
Mean	**24.18**	**20.14**	**4.04**		**19.82**	**20.14**	**3.79**	**16.14**

Table 4. Grain yield qt/ha of improved chickpea variety at Kersamalima district, 2016/17-2017/18 cropping season.

Farmer	Grain yield qt/ha of variety Habru			Grain yield qt/ha of variety Natoli
	2016/17	2017/18	Mean of Two years	2016/17
F1	25.5	24.5	25.0	23.0
F2	19.5	22.5	21.0	22.5
F3	23.0	24.5	23.7	25.0
F4	21.0	23.0	22.0	22.4
F5	23.5	30.0	26.75	24.5
Mean	**22.5**	**24.9**	**23.7**	**23..48**

Table 5. Mean yield advantage and percent yield increase of improved chickpea variety over national average yield qt/ha at Kersamalima 2016/17-2017/18 cropping season.

Farmer	Mean of two years for var. Habru	National ave. yield of 2016 & 2017	Yield adv. over national	% yield increase over national	Grain yield of variety Natoli 2016	National average yield of 2016	Yield adv.	% yield increase
F1	25.0	20.14	4.86	19.44	23.0	19.69	3.31	14.39
F2	21.0	20.14	0.86	4.1	22.5	19.69	2.81	12.49
F3	23.7	20.14	3.56	15.02	25.0	19.69	5.31	21.24
F4	22.0	20.14	1.86	8.46	22.4	19.69	2.71	12.10
F5	26.75	20.14	6.61	24.71	24.5	19.69	4.81	19.63
Mean	**23.7**	**20.14**	**3.56**	**15.02**	**23..48**	**19.69**	**3.79**	**16.14**

Table 6. Mean Grain yield, yield advantage and % yield increase qt/ha of improved chickpea variety over national average at Kersa malima and Sebeta Awas district demonstrated in 2016/17-2017/18 cropping season.

Farmer	Mean grain yield qt/ha					
	Habru	Natoli	variety mean	national average	yield adv	% yield increase

Farmer 1	23.25	19.25	21.25	20.14	1.11	5.22
Farmer 2	24.48	21.9	23.19	20.14	3.05	13.15
Farmer 3	24.1	20.88	22.49	20.14	2.35	10.45
Farmer 4	23.75	21.47	22.61	20.14	2.47	10.92
Farmer 5	25.3	22.88	24.09	20.14	3.95	16.40
Farmer 6	24.0	23.6	23.80	20.14	3.66	15.38
Mean	**24.15**	**21.66**	22.91	**20.14**	2.77	12.09

Farmers' perception

The first year result of pre-harvest and post-harvest selection criteria of farmers' preference rank at Sebeta Hawas showed that variety Natoli was selected first followed by Habru in overall plant performance (Table 3). On the other hand, the pre-harvest and post-harvest selection criteria of farmers' preference rank at Kersa Malima showed that variety Habru was selected first followed by Natoli (Table 4). However, in the second year farmers' evaluation was not conducted because variety Natoli was highly affected by Ascochyta blight disease of chickpea at both locations (Figure1) specifically in Kersa malima district it was totally lost by this disease and no crop harvest was done. At Sebeta Awas demonstration plots planted early in the season was affected by Ascochyta blight of chickpea. The reason for the high severity of the disease in 2017/18 cropping season was due to an early planting and extended rainfall starting from the month of September which creates a favorable condition for the spreading of the disease.

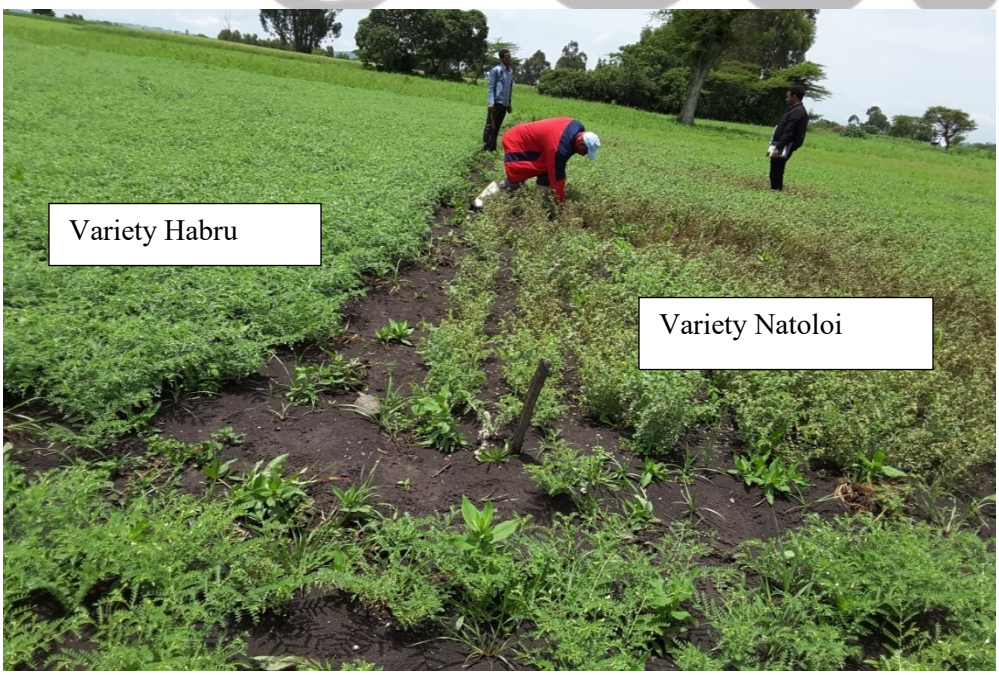

Figure 1. Performance of variety Habru in the left and Natoli in the right at Kersa Malima district, 2017/18 season.

Table 2. Summary of overall performance scores and rank of chickpea variety demonstrated at two districts, 2017/18 season.

Parameters	Demonstrated Variety at two districts					Variety mean performance scores		
	Sebeta Hawas			Kersa Malima		Habru	Natoli	local*
	Habru	Natoli	Local	Habru	Natoli			
Branching ability	24	24	24	12	18	18	21	24
Disease resistance	20	36	40	20	20	20	28	40
Insect resistance	45	20	55	15	30	30	25	55
Pod load	20	8	20	15	30	17.5	19	20
Plant stand	7	5	12	1	2	4	3.5	12
Marketability	4	10	12	3	6	3.5	8	12
Seed size	16	24	48	12	24	14	24	48
Seed color	8	16	18	6	12	7	14	18
Overall scores	**144**	**143**	**229**	**84**	**142**	**114**	**142.5**	**229**
Rank	**2**	**1**	**3**	**1**	**2**	**1**	**2**	**3**

Note: Rating score: 1 = good, 2 = medium, 3 = poor

Training:

Field practical training was provided to farmers, development agents and district agricultural experts about chick pea production, management and marketing activities. In general 61 participants consisting of 25 farmers and 36 others (i.e. DAs, district agricultural experts, administrators) were trained.

Field days

With the intension to demonstrate the varieties and their production package and to collect feedback from farmers and other stakeholders, a field day was conducted at Kersa Malima district on October 24, 2016. The major aim of organizing field days is to promote information exchange and technology transfer easily from farmers to farmers or among different stakeholders and at the same time creating market linkages (making market value chain) in which producers can directly or indirectly benefited from processer in a mutual system.

In this event, about 175 participants from different stakeholders took part. Among these, 100 were farmers of which 25 were females. Others were 30 development agents, 20 zone and district level agricultural experts and 25 were researchers. From the total participants 25% of them were female and the rest were male. . During the field day, the participants visited the on-farm

demonstration trials, impressed by the work done and good implication of the potential productivity of the land with good agro-ecology of the area, awareness on the research interventions have also been created and the feedback received for the future scaling. In this field day:

- Improved chickpea technologies were introduce to surrounding farmers, agricultural experts and development agents
- participants share experience and good farming practices and engage in discussion to learn from each other
- Linkage between research, BoA, farmers and different stakeholders was strengthening. feedback about the performance of technologies was collected

Farmer's feedback:

Accordingly farmers and participant feedback were collected and presented as follows

- Farmers explained that the improved variety with their production package have high yield potential over the local variety
- Farmers at Sebeta Hawas commented that Natoli variety was better in yield but because of its red color don't meet the local market quality demand. Currently white color seeded grain is more preferable than the red ones.
- Farmer to farmer technology transfer needs to be enhanced through different means (training, field days)
- On time delivery of inputs (seed) needs to be improved

Conclusion and recommendation

The demonstration activity clearly showed the superiority of the improved package over the local. Among the two improved varieties the farmers' mostly preferred the variety Habru over Natoli due to its disease resistance, market preference (large seed size and whit seed color). In order to optimize the participation of different stakeholders at various levels of chickpea technology generation, transfer and utilization process, strong linkages need to be created among different actors such as researchers, extensionists, farmers, private sector, policy makers, MoA and NGOs in order to hasten the entire process of chickpea technology generation and transfer. Emphasis must be given to multiply these seeds on a large-scale in order to reach many farmers. Specific training programs on improved chickpea technologies need to be continued for farmers, DAs, SMSs in areas where it has been started.

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Challenges

- **Ascochyta blight -** Though it was not appeared in the first year, this disease has occurred in the second year due to heavy rain and inflicted heavy yield loss on farmers that grew Natoli variety.

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