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Research Article

Pre-Extension Demonstration of Kik Type Field Pea (Pisum Sativum L.) Varieties in Selected Highland Districts of Guji Zone, Southern, Oromia, Ethiopia

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Abstract

In Ethiopia, many varieties were released to improve field pea yield at different locations. However, field pea's productivity is low because the released and improved varieties were not demonstrated at farms. Therefore, demonstrating improved field pea varieties is an entry point to large extension production. Hence, this study was conducted in three highland districts of the Guji zone to evaluate the yield and profitability of kik type field pea varieties on farmer's land. An improved variety named Burkitu and local varieties were demonstrated on 12 experimental farmers in 2022. Yield data and production costs were collected and analyzed by descriptive statistics, and the profitability of varieties were estimated by cost benefit analysis. The results showed that kik type Burkitu variety generated a yield of 23.58 qt/ha compared to 18.33 qt/ha of local variety. The result of cost benefit analysis also indicated that Burkitu (97005 birr/ha) variety gave better returns than the local variety (54022 birr/ha). Based on higher yield, disease tolerant and market demand Burkitu variety was preferred by farmers. Using improved field pea varieties was important for higher yield and return. Hence, farmers should use Burkitu for kik type field pea production. Further research is needed to promote Burkitu as scaling up varieties in the highland areas of the Guji zone.

Keywords: Agricultural Extension; Demonstration; Field pea; Burkitu variety; Guji zone

Introduction

Field pea (Pisum sativum L.) is a self-pollinated diploid (2n=14) annual pulse crop. It is also a major food legume with a valuable and cheap source of protein having essential amino acids that have high nutritional value for resource-poor households [1]. It is a fundamental source of high-quality proteins, micronutrients, starch, phenolic compounds, dietary fibers, and antioxidants [2]. It is widely grown in the cooler temperate zones and the highlands of tropical regions worldwide. The crop has the potential of growing in variable ranges of altitudes from 1800-3000 masl [3-4]. The crop is cultivated in a wide range of soil types from light sandy loam to heavy clay, but does not tolerate saline and waterlogged soil conditions [5].

Field pea ranks second worldwide pulse production [4,6,7]. The crop occupies the fourth rank of pulse crops production next to faba bean, haricot bean and chickpea in area coverage 219,927.59 ha with an average yield productivity of 1.71 t/ha in Ethiopia [8]. The major food legumes with valuable and cheap protein sources having extended essential amino acid (21-26%) have high nutritional values for resource-poor households [10].

The crop has ecological and economic importance in Ethiopian highlands as it plays a significant role in soil fertility amendment and as a break crop. It is suitable for rotation systems to minimize the negative impacts of cereal-based mono-cropping [10,7]. It is also used as a source of income for the farmers and foreign currency for the country [11-12].

Despite its importance, the average national productivity (1.7 t/ha) is very low [8] compared to the crop potential yield (3.556 t/ha) [13] and 4.17 t/ha on research [14] and the higher yielder (7-8 t/ha) reported at some European countries [15]. Low production is mainly due to farmers' use of unimproved cultivars [14,16-17]. On the other hand, over 80 improved field pea varieties have been released to be grown in high-altitude areas of the country [18]. Farmers did not intensively produce these varieties. Farmers did not get varieties or know the potential of released varieties. That is why the government of Ethiopia focused on demonstrating released varieties before large-scale extension production.

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Field pea is a major pulse crop grown in highland areas of the Guji zone, Southern Oromia. The crop is used in different forms; some people use it as *shiro* (powder form used to make *wat*, which is mainly used with *injera*) at home and in hotels. Field pea is also used as *kik* type (the pea divided into two by grinder and it will be boiled and used with wat for consumption) while other people consume it as roasted form. Farmers used *kik* type and *shiro* type interchangeably based on the availability of the varieties. But, currently, both types were not fully available in rural farming due to a lack of improved varieties. The price of meat with good protein for human beings is increasing at farmers and people cannot afford it. Field peas, like other pulse crops, can substitute meat to give essential protein to households. However, field pea production becoming low leads to low amount of protein required for the human body. This calls for large production of field peas for the human diet by demonstrating and popularizing released field pea varieties. Almost all farmers in the Guji Zone were used local field pea varieties [18]. Hence, there is low production of field peas regardless of the potential of highland areas available for production. On the other hand, field peas are in high demand at household and national level due to its nutritional and high price. Therefore, prior to large production demonstration of released and adapted varieties is important in potential areas of the Guji zone. The objectives of the study were to: evaluate yield performance of improved kik type field pea varieties, evaluate the profitability of the improved kik type field pea varieties under farmers' conditions and assess farmers' feedbacks for further development of kik type field pea production at highland areas of the Guji zone.

Methodology

Sites and Experimental Farmers Selection

This activity was conducted in three highland districts of the Guji zone. Arda Jila Mea Boko, Bore and Ana Sora districts were purposively selected based on their field pea production potential. From each district, two *kebeles* were selected. Three (3) experimental farmers per *kebele* were selected.

Materials and Research Design

Kik type field pea named Burkitu variety was demonstrated with a local variety sown on selected experimental farmer's land in 2022. Each variety was sown by 12 experimental farmers on a plot of 10m×10m. The recommended seed rate of 100kg/ha, 100kg/ha of NPS, 40cm between rows and 10cm between plants were used at demonstration. Training and the mini-field day were used to enhance farmers' knowledge and skills on improved field pea production, while the mini-field day was used to popular field pea in highland districts of study areas.

Methods of Data Collection and Analysis

Observation, measurement and interview were used to collect the data. Yield and production costs of field pea seed, land preparation, sowing, fertilizer, seed, harvesting, weeding and cost of land rent were collected. Descriptive statistics were used to analyze the data, while cost benefit analysis was used to estimate the profitability of demonstrated varieties. Total revenue was obtained by multiplying the yield of field pea by the farm gate price. Farm gate price was the reply of farmers' price selling field pea at threshing time. In this study, the total variable cost was the summation of costs of seed, fertilizer, land preparation, sowing, weeding, harvesting and threshing. The fixed cost was the cost of land used for field pea production during the production year. Total cost was obtained by summation of total variable cost and fixed cost. In this demonstration, the profitability of field pea was estimated by cost benefit analysis, which was obtained by subtracting total variable cost and fixed from total revenue. Benefit cost ratio was obtained by dividing the total revenue by the total cost of field pea production. Farmers' perceptions toward field pea varieties were analyzed in narration form.

Results and Discussions

Training of Stakeholders

The training was organized to refresh and enhance linkage with stakeholders. Farmers, development agents, subject matter specialists and others were trained in field pea production in all districts. This training was given to improve farmers and development agents in enhancing the production and productivity of field pea. Accordingly, 182 farmers, 33 Development Agents (DAs) and 25 Subject Matter Specialists (SMSs) were trained during field demonstration. Additionally, 51 farmers and stakeholders participated in a mini field day on the demonstrated site (Table 1). They observed that the participants accepted improved field pea varieties and were eager to produce field pea on their land given that improved varieties were provided by research centers and/or obtained from other sources. When technology users capacitated, the technology transfer from research recommendation to technology user is simple, so the agricultural extension system should focus on capacity building [19].

Table 1: Participants in *kik* type field pea varieties demonstration.

Extension method	Participants											
	Farmers			Das			SMS			Others		
	M	F	T	M	F	T	M	F	T	M	F	T
Training	165	17	182	24	9	33	18	3	25	4	-	4
Mini field day	43	8	51	4	2	6	4	-	4	2	-	2
Total	208	25	233	28	11	39	22	3	29	6	-	6

M=Male, F= Female, T= Total, DAs=Development Agents, SMSs= Subject Matter Specialists.

Yield Performance of Demonstrated Field pea Varieties

The result of this demonstration showed that improved *kik* type variety produce more yield compared to the local variety. This indicated that Burkitu improved varieties generated a mean of 23.58 qt/ha (Table 2). Burkitu gave a yield advantage of 5.25 qt/ha over the local variety. This demonstration's yield was higher than Ethiopia's national yield (17 qt/ha) [8]. This showed that highland areas of Guji where this activity was conducted had potential for field pea production. During the demonstration, Burkitu generated a maximum of 31 qt/ha seed yield. This

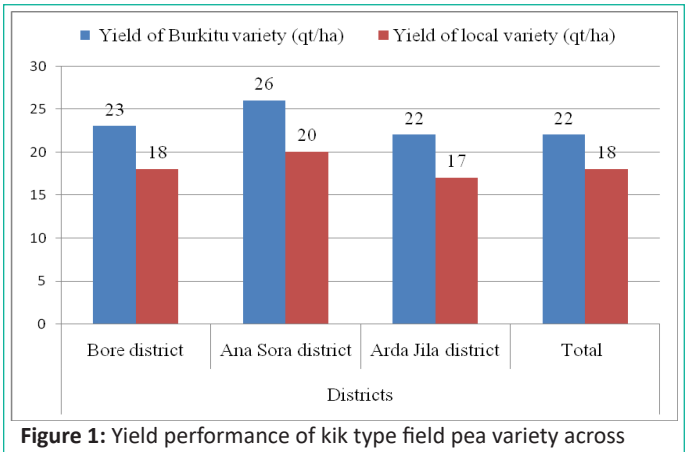

Figure 1: Yield performance of kik type field pea variety across districts.

Table 2: Yield performance of *kik* type field pea varieties (qt/ha).

District where the activity conducted		Varieties	
		Burkitu	Local
Bore	N	3	3
	Minimum	21	15
	Maximum	24	20
	Mean	22.67	17.67
	Std. Deviation	1.53	2.52
Ana Sora	N	4	4
	Minimum	23	15
	Maximum	31	22
	Mean	26.00	19.50
	Std. Deviation	3.56	3.12
Arda Jila	N	5	5
	Minimum	20	15
	Maximum	25	20
	Mean	22.20	17.80
	Std. Deviation	1.92	2.28
Total	N	12	12
	Minimum	20	15
	Maximum	31	22
	Mean	23.58	18.33
	Std. Deviation	2.91	2.53

indicated use of an improved variety of Burkitu field pea can increase the yield of field pea at the highlands of the Guji zone. The result of this demonstration was similar to the study of [20] showed that on station Burkitu can gave 25.95 qt/ha yield. His study also reported the yield result on the farm of Burkitu (19.40 qt/ha) was lower than on the station. This showed yield variation between on-station and farms where on-station was managed by the researcher while on farm trial was managed by farmer's management is a major factor for yield variation. In addition, [21] indicated that 23 qt/ha was harvested from Burkitu variety, and the highest yield of 43 qt/ha was obtained from Burkitu [22]. This result was higher than the currently demonstrated yield due to variations in management practices by farmers and climate conditions. In addition, Burkitu were eaten by wild animals at the vegetative stage and human beings at the pod stage due to the varieties sweetness. This led to a lower yield of varieties at the demonstration, so further production of improved field pea should be at the homestead, where there is close supervision from wild animals and humans. More yields from the three highland districts were obtained from Burkitu variety in the Ana Sora district, followed by the Bore district (Figure 1). This showed that regardless of the attack of wild animals and human beings, Bore and Ana Sora districts were more suitable for *kik* type field pea production in the highlands of the Guji zone.

Independent t-test was used to explain the mean difference between demonstrated field pea varieties. There was 5.25 qt/ha mean difference between Burkitu and the local variety. Based on the results of the independent t-test ($p=0.001<0.05$), it was concluded that there was a significant difference in yield between Burkitu and the local variety in the study area (Table 3).

Table 3: Independent Samples Test.

Yield of variety (qt/ha)	t-test for Equality of Means						
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variances assumed	4.716	22	.001	5.25	1.11	2.94	7.55
Equal variances not assumed	4.716	21.60	.001	5.25	1.11	2.93	7.56

Profitability of kik Type Field pea Production

Yield alone is not a matter for farmers. Farmers would adopt a variety when the variety generates surplus income, which can be used for other business in the farmers' context. Therefore, conducting profitability of variety in this demonstration is necessary to indicate whether the return was above the costs of field pea production. The farm gate price of the local variety was 4000 Birr/qt, while the improved variety of Burkitu was 5000 Birr/ha at production time. The burkitu variety generated an income of 97005.83 Birr/ha, while the local variety of field pea generated a return of 54022.50 Birr/ha, half of the improved variety of Burkitu. Burkitu had a more cost benefit ratio (5.58) than local variety (3.5) (Table 4). The result of cost benefit revealed that the production of the improved variety of *shiro* type (Bilalo) and *kik* type (Burkitu) had generated a surplus income over the local variety in the highland areas of the Guji zone.

Farmers' Preference and Feedback on kik Types of Field pea Varieties

Before the demonstration, there was no land left for field pea production due to the local seed variety was affected by pod borer. In addition, farmers were tired with low yield and disease was affecting the local variety in the area. No pure and uniform variety is obtained in the community due to seed segregation over time. By this demonstration, however, Burkitu variety was preferred by farmers due to its higher yield, disease tolerant, purity and market demand as the seeds were uniform. Compared to the local, Burkitu variety had many branches and pods, contributing to high yield for farmers. The demand of field pea is high due to almost all people use field pea for daily consumption. Therefore, with production of improved field pea such as Burkitu farmers can get more returns, which can increase the bargaining power of farmers in agriculture and other businesses. The white color of Burkitu variety was highly demanded at the market.

Table 4: Profitability of kik type field pea production.

Parameters	N	Min	Max	Mean	Std. Deviation
Yield of Burkitu (qt/ha)	12	20	31	23.58	2.91
Yield of local variety (qt/ha)	12	15	22	18.33	2.54
Price of Burkitu (Birr/qt)	12	5000	5000	5000.00	.00
Price of local variety (Birr/qt)	12	4000	4000	4000.00	.00
TR of Burkitu = yield*price (Birr/ha)	12	100000	155000	117916.67	14531.84
TR of local = yield*price (birr/ha)	12	60000	88000	73333.33	10138.44
TVC of Burkitu (Birr/ha)	12	12350	13400	13119.17	276.09
TVC of local (Birr/ha)	12	10750	11800	11519.17	276.09
FC of land (Birr/ha)	12	7500	8000	7791.67	257.46
Total cost = TVC+ FC (Birr/ha)	12	19850	21400	20910.83	417.079
CBA of Burkitu (Birr/ha) = TR of Burkitu-TVC-FC	12	78800	134100	97005.83	14725.95
CBA of local (Birr/ha) = TR of local-TVC-FC	12	40200	69050	54022.50	10366.59
BCR = TR/TC of Burkitu	12	5	7	5.58	
BCR of local = TR/TC of local	12	3	4	3.50	

Table 5: Farmers' selection criteria for kik type field pea varieties.

SN	Varieties	Rank	Reasons for rank
1.	Burkitu	1st	Higher yield, disease tolerant and highly demanded at market
2.	Local	2nd	Lower yield, susceptible to disease and mixed seed so that not highly demanded at market

Conclusions

Improved varieties were important for the increment of agricultural production. For this reason, many improved varieties were released by research centers. Unless farmers used varieties, releasing varieties alone did not increase crop yield. To be used by farmers' varieties must be shown to the farmers. However, released and improved varieties were not demonstrated on farmer's land for larger production. Therefore, agricultural extension should focus on demonstration, an entry point for large production to feed the increasing human population. This field pea demonstration was conducted on the highlands of the Guji zone, where the Burkitu variety was demonstrated with local variety to indicate their potential on farmer's land. Accordingly, the Burkitu variety was a higher yielder than the local variety. The production of the Burkitu variety generated feasible returns for farmers. Compared to local, the Burkitu variety was preferred by farmers based on their higher yield, disease tolerance, purity and market demand.

The scope of this activity was limited to small areas of few farmers due to shortage of time and facilities. Further research is needed to disseminate and extend the Burkitu field pea variety in the highland areas of the Guji zone. Burkitu variety should be provided by research and agricultural office. The promotion of Burkitu varieties in the form of scaling up and multiplication in potential highland areas of the Guji zone is needed in larger areas. The role of agricultural extension is to promote agricultural technologies to the end users. Many agricultural research centers used the demonstration to transfer improved/new variety or technology to the end users. Before going to larger production by extension, varieties should be tested and validated by farmers to reduce risk associated with the failure of new varieties. Hence, a pre-extension demonstration is important in agricultural research variety transfer. Breeders should focus on releasing new varieties which are better yield and disease tolerant while extension should transfer released varieties to the farmers at the right place.

Author Statements

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