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Full Length Research

Participatory Varietal Selection and Agronomic Performance Evaluation of Kik-Type Field Pea Varieties in Guji zone, Southern Ethiopia

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Abstract: In the main cropping season of 2021, a field experiment was carried out in the Bore, Dama, and Anna Sora districts of the Guji Zone on stations and farmers' fields. The experiment's goal was to compare agronomic traits with farmer input to evaluate on-farm varieties, choose farmers' favorite varieties, and then recommend the best performing varieties for the Guji Highland field pea production regions. At the Bore Agricultural Research Center, an on-station experiment was conducted utilizing RCBD with three replications. Ten enhanced kinds that were introduced both nationally and regionally were tested and chosen based on their desirable characteristics. From each district, two farmer's fields were used, and the farmer's fields were replicated. Farmers employed a variety of factors in addition to agronomic information, such as days to blooming, plant height, pods per plant, and seed per pod, to evaluate field pea varieties. Growth habits, production performance, disease and insect resistance, marketability, and diet compatibility were the main selection criteria used by farmers. The majority of farmers chose the Burkitu variety, followed by the Bamo variety, based on the selection criteria. The analysis of the agronomic data also showed that the selected varieties for the farmers were chosen for their high yielding and other assessed qualities. Bilalo had the highest seed yield (4167 kg/ha), followed by Bamo (3312 kg/ha), and Adi (3104 kg/ha), according to the results of the combined analysis.Due to its excellent grain output, appealing seed color, large seed size, and overall preferable field

performance, the Burkitu variety was chosen. These findings suggested that farmers had a thorough understanding of how to choose and decide on the chosen better varieties in comparison to the inferior types.
Keywords: Farmers' Criteria: kik-Type: Participatory Selection: Ethiopia
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1.0 Introduction of the Study

One of the cool-season legume crops produced for several purposes in various agro-ecologies is the field pea (Pisumsativum L.) (Mckay, 2003). The crop is commonly grown in Ethiopia at mid to high altitudes, where it ranks second among highland pulses in terms of area coverage (219,927.59 hectare) and yearly output (3,762,368.83 quintals) (CSA 2021). It is the most significant food legume, a valuable and affordable source of protein with necessary amino acids (23-26%), and it is primarily consumed by homes with limited resources (Kapila, 2012; Olusesi & Joshua, 2022; Owhe-Ureghe et al., 2022). The crop is an important rotation crop for restoring soil fertility because it fixes atmospheric nitrogen, reducing the need for fertilizer for low-income farmers (Stenvovic, 2005; Keneni, 2013). Additionally, it serves as a source of revenue for farmers and a source of foreign exchange for the nation (Girma, 2003; Shahidur, 2010).

When compared to the global production of 2.4t per hectare (FAOSTAT 2019), Ethiopia's average yield of the crop is much below its potential 1.71t ha-1, despite its numerous relevance and large area coverage (CSA 2021). The main cause of the crop's low yield is the limitations in addressing enhanced field pea varieties to possible agro-ecologies. Despite the fact that numerous improved field pea varieties have been released by various regional and federal research centers to meet the needs of smallholder farmers (MOA 2018), the production of field pea is currently limited in the Guji Zone due to the low yielding of farmers' varieties that are heavily impacted by several factors like diseases and insect pests. Farmers have not been made aware of the available varieties, and there is a lack of information regarding recently released varieties that are compatible with the region's current cropping strategy.

The lack of sufficient improved varieties with widespread acceptance, agronomic practice, and other restraints are the other major issues behind poor farmer participation in the selection process (Kapinga, 2003; Egan & Bamfo-Agyei, 2023; Gebeyehu et al., 2022). Currently, the bulk of the varieties that have been made available in Ethiopia have been chosen based on their limited agronomic characteristics and unique breeder's criteria that mostly emphasize high yield and disease resistance. In light of this, a number of variables may be to blame for the slow uptake of new cultivars.

The breeders' selection criteria might not correspond with the needs and preferences of producers, which is the first cited factor (Abdulkadir et al., 2022; Ukonu et al., 2022). Farmers take into account a number of qualities to meet their unique needs, which helps to assess whether a variety with desired traits will be accepted. Similar research found that the traits used in farmer selection are multivariate in nature (Asfaw, 2012). One key strategy for identifying and evaluating features that are significant to small-scale farmers is to involve farmers in variety evaluation (Asrat, 2008). It aids in evaluating "subjective traits" that can be challenging for breeders to truly assess and challenging to measure numerically, such as flavor, color, size, market demand, and other culinary qualities (Vom, 2010).

The key to breeding programs being able to issue variations that farmers will accept is to understand their preferences in the evaluation and selection of variants (Dorp & Rulkens, 1993). Therefore, participatory variety selection is the fundamental method for breeding, which involves bringing together breeders, social scientists, farmers, and extension agents in a field environment to collaboratively evaluate novel varieties, prioritize, and target important qualities alongside already-existing local variations (Kapinga, 2003; Ayua et al., 2023; Abdulkadir & Ajagba, 2022). Therefore, the purpose of this study was to compare the agronomic performance of several field pea varieties and evaluate them in conjunction with farmers in order to determine which variety they preferred.

1.1 Resources and Procedures

Two different methods of the study's execution were used: (I) on-station as mother trial, and (II) on-farm as infant trials.

1.2 Experimental Site Description (on-station)

The experiment was conducted at the Bore Agricultural Research Center, Guji Zone of Southern Oromia, one of the recently created Research Centers of the Oromia Agricultural Research Institute (OARI), for three years in a row during the main cropping season. The site of the Bore Agricultural Research Center lies just off the main road that leads to Addis Abeba via the town of Hawassa, some 8 km north of the town of Bore.The experimental location is located at a height of 2728 m above sea level, between the latitudes of 06^{o}23'55"N and 06^{o}24'15"N and the longitudes of 38^{o}34'45"E and 38^{o}35'5"E. The study area corresponds to the highlands of the Guji Zone, which are known for their heavy rainfall and bimodal rainfall distribution. The second rainy season begins in late November and lasts until the beginning of March, while the first rainy season lasts from April to October.

1.3 On-Station

Three districts' farmers' fields were used for the study. Two farmer fields in each district were chosen to serve as the site of the on-farm participatory trials with the assistance of the district agricultural extension personnel. There were two replications per district because each farmer was classified as a separate replication.

2.0 Materials for Experiments

Ten improved field pea varieties, including the local check, were assessed for adaptability and performance on yield and yield components. These varieties included Arjo-1, Burkitu, Dadimos, Tulu-Dimtu, Bamo, Tegegnech, Adi, Gume, Markos, and Urji. Agricultural Research Centers at Holeta, Sinana, and Bako announced these enhanced varieties.

Table 1: List of field pea varieties

SN	Varieties	Year of release (GC)	Maintainer (ARC)	Character
1	Burkitu	2009	Holeta	Kik type
2	Tulu-Dimtu	1999	Sinana	Kik type
3	Adi	1995/96	Holeta	Kik type
4	Gume	2006	Holeta	Kik type
5	Tegegnech	1993/94	Holeta	Kik type
6	Urji	2007	Sinana	Kik type
7	Markos	1994/95	Holeta	Kik type
8	Arjo-1	2005	Bako	Kik type
9	Bamo	2005	Bako	Kik type
10	Dadimos	1994/95	Sinana	Kik type

2.1 Experimental Planning and Methods

Three replications of the experiment were run using a Randomized Complete Block Design (RCBD). The experimental plot has four rows of a 6m2 net plot and six rows of 3m x 2.4m with six rows each. Blocks (replications) were set 1.5 meters apart, whereas plots were 1 meters apart. Prior to seeding, the experimental field was prepared using best practices for field pea cultivation. The field was leveled, plowed, and prepared with rows spaced 20 cm apart. All other suggested agronomic techniques were used consistently across all experimental plots.

2.2 Gathering and Analyzing Data

On-site agronomic data (mother trial): The performance of the field pea varieties is assessed using all agronomic characteristics, including days to blooming, plant height, pods per plant, seeds per pod, days to maturity, thousand seed weight, and grain yield. Ten randomly selected plants from the middle four rows of the garden provided all the data. Analysis of variance (ANOVA) was performed on all recorded data using SAS 9.4 at P 0.05. The Duncan's Multiple Range Test (DMRT) of mean comparison was used to see whether there were any appreciable changes between the treatment means.

2.3 Farmer's Data on-Farm (Baby Trials)

In addition to the qualities determined for the study, the best varieties for eight additional attributes were evaluated and chosen using participatory on-farm trials. Growth behavior, grain color, seed size, early maturity, yield performance, marketability, diet suitability, and disease resistance were the eight attributes. A total of 43 farmers—27 men and 16 women—participated actively in the evaluation of the varieties. Agronomic information gathered from both on-farm and on-station studies was analyzed and compared with all comments and features that farmers valued or thought were essential from individual farmer and focus group talks. The evaluation of the trials began as soon as the crop emerged.While selection for the traits of grain yield, seed color, seed size, diet appropriateness, and marketability was done after harvest and thrown away, variety selection for the traits of growth habit, earliness, disease, and total yield attribute was carried out close to physiological maturity. Based on farmers' selection criteria, varieties were ranked using the rank sum approach for each feature for each variety. Each trait's worth is equally weighted. Each selection criterion for each variety was ranked from 1 to 5 (1 = Very poor, 2 = Poor, 3 = Average, 4 = Good, and 5 = Very good) after the ranking process was described to the participating farmers. According to farmers' preferences, simple ranking is a common method for identifying promising cultivars (De Boef & Thijssen, 2007). In order to minimize bias, varieties were recognized during the assessment by their plot numbers rather than their names, as recommended by (Kapinga, 2003). Data on yield was collected for each plot and then translated to yield per hectare.

3.0 Discussion of the Findings

3.1 Performance in Agronomy

The findings of the analysis of variance showed that most of the studied agronomic parameters show significant variation between varieties (Tables 2). No one variety was identified that demonstrated consistently improved performance in all measured traits across the two testing settings, despite differences in agronomic performance and disease reactivity amongst varieties. However, one variety was shown to be better to the others in the majority of attributes. Accordingly, the highest in plant height, pod per plant, seed per pod and thousand seed weight were recorded from Burkitu variety with mean grain yield of 4167 kg ha-1 in mother trial and trials followed by Dadimos with mean grain yield of 3720 kg ha-1 at on-station; while the intermediate to lower values of agronomic traits were recorded from varieties, TulluDimtu, Gume, Urji, Bamo, Tegegnech, Markos, Adi, and Arjo consecutively (Table 2). To determine whether the farmers' preferred varieties were approved or rejected, it was necessary to compare the agronomic performance with their perception and criteria.

Table 2: Averages of growth, yield components, and mother trial yield

Varieties	Mean values					
	PH (cm)	NPPP	NBPP	NSPP	HSW (g)	GY (Kg ha^{-1})
Burkitu	182.1	49.58^{a}	0.58	5.42	21.63^{a}	4167^{a}
Tulu-Dimtu	197.8	31.92^{ab}	1.42	5.13	20.03^{abc}	3537^{ab}
Adi	201.8	34.17^{ab}	0.83	5.33	19.20^{abc}	3104^{bc}
Gume	202.4	36.42^{ab}	1.00	5.75	18.97^{abc}	3326^{bc}
Tegegnech	209.2	35.33^{ab}	1.08	5.58	20.83^{abc}	3021^{bc}
Urji	201.7	26.58^{c}	1.08	5.67	19.33^{abc}	3275^{bc}
Markos	203.4	44.42^{ab}	1.50	5.83	21.20^{ab}	3113^{bc}
Arjo	229.3	29.08^{ab}	1.08	6.08	18.13^{bc}	2940^{c}
Bamo	208.3	40.75^{ab}	1.66	5.17	17.73^{c}	3312^{bc}
Dadimos	194.0	47.92^{ab}	1.83	5.25	21.0^{abc}	3720^{ab}
LSD (0.05)	NS	22.44	NS	NS	3.46	1261.55
CV (%)	11.5	24.8	24.2	7.2	10.2	21.9

Keys: P H= plant height, NPPP=number of pod per plant, NBPP= Number of branch per plant, NSPP= number of seed per pod, HSW= hundred seed weight, GY= Grain yield

3.2 Farmer Preferences and Variety Ratings

About eight different features were mentioned for the farmers who participated in participatory varietal selection and which helped them choose which field pea varieties to adopt (Table 3). The participants rated each attribute either as important or as being most important. Farmers therefore take into account a variety of features, but it's important to pinpoint a handful that they frequently employ. Farmers employing a mix of a few features when evaluating new varieties was found in a prior study (Asfaw, 2012) on common beans. According to this study, the most crucial factors farmers considered when choosing varieties of field pea for adoption were growth habit, disease reaction, yield performance, seed color, seed size, earliness, marketability, and diet suitability (Table 3). According to the results of the one-on-one interviews conducted at each site, the majority of farmers favored cultivars that were resistant to disease, grew and continued to bloom, and had good pod loads and pod length. These criteria were determined to be the main deciding factors and their decision-making criteria to keep or reject a variety, with the other criteria serving as descriptors to choose a good variety.

The last criterion being a descriptor to choose from a decent selection. Farmers graded the tenth released field pea varieties on a scale of 1 to 5 (where 1 is very poor, 2 is poor, 3 is average, 4 is acceptable, and 5 is very good). All types were graded 1–10 according to the mean value of farmers' perceptions (Table 3). Despite having very equal perceptions for several features, the variation 'Burkitu' was favoured by a large number of participants and superior to the others in most of the tested traits, followed by the 'Bamo' variety (Table 3). While the two remaining varieties had lower rank and relatively similar log odds ratios for growth habit, earliness, yield, marketability, and diet suitability, but varied in disease reaction, seed size, and seed color, Adi was also one of the competent varieties and the preferred variety in the majority of traits. Similar to this, Vom (2010) observed that since good qualities are rarely seen in a single variety, there is a better likelihood of sustaining on-farm diversity when there is more variation in the selection criterion. Although it is impossible to discover a single variety that satisfies every requirement of the farmer (Dorp & Rulkens, 1993), the analysis of the farmers' preference score revealed that

"Burkitu" has received the greatest amount of farmer preference and has undergone the most positive selection. Overall, according to the combined farmers' view, Burkitu, Bamo, and Adi were ranked first, second, and third, respectively, while the remaining kinds were ranked fourth through tenth, sequentially (Table 3).

Table 3.Mean value of each farmer's selection traits and ranking of varieties

	Varieties									
Farmers' Trait	Burkitu	Gume	Adi	Tegegnech	Tullu-dimtu	Urji	Markos	Bamo	Arjo-1	Dadimos
Pod Bearing(PB)	12.6	7.9	9.9	9.0	7.3	9.3	5.6	10.4	12.7	7.1
Earliness (EL)	10.5	9.4	9.1	11.4	11.9	11.4	8.3	12.4	6.2	11.2
Synchrony of Maturity (SM)	15.0	9.8	8.5	13.9	13.7	9.9	8.4	13.8	9.6	8.3
Free of disease and insect Pest	13.5	6.1	12.4	9.7	8.4	6.7	6.5	11.2	10.2	5.4
Shattering (SH)	13.3	9.2	11.2	11.1	8.6	9.0	11.1	12.4	14.4	10.6
Seed size (SS)	14.9	10.1	11.8	9.6	9.1	11	10.3	12.5	12.3	11.2
Seed color (SC)	13.0	10.3	13.6	9.3	10.9	13.1	9.0	13.6	12.8	11.1
Market value (MV)	13.9	9.6	13.5	9.7	10.2	12.1	9.5	13.0	13.2	10.4
Overall performance (OAP)	12.9	9.1	10.8	9.5	8.4	9.8	7.2	11.0	11.0	7.1
Total	119.6	81.5	100.8	93.2	88.5	92.3	75.9	110.3	102.4	82.4
Mean preference rating	13.29	9.06	11.20	10.36	9.83	10.26	8.43	12.26	11.38	9.16
Rank	1	8	3	5	7	6	9	2	4	10

4.0 Conclusions and Recommendations

The analyzed results of this study indicated that field pea variety in Guji zone is greatly influenced by the low yielder and market; thus, farmers seek for varieties that give them a high yielding and marketing edge. Farmers preferred variety with good seed color and size which is attractive or marketable at a premium price for income purpose, while yield and culinary qualities for consumption. Researchers must consider farmers selection traits in their varietal development including seed yield, seed size, and seed color, market value and overall field performance. Besides, the training given during participatory variety selection process enhances capacity of the farmers for identifying varieties and managing varietal diversity. Therefore, field pea variety with a combination of traits such as disease resistance/tolerance, early maturity, high yield, large seed size, white-yellowish color, and good taste have a higher likelihood of being accepted by farmers in the Guji zone of Oromia. Based on farmers' selection criteria, variety Burkitu and Bamo were selected as the first top ranking varieties respectively at all three farmer sites. Therefore, these two varieties are recommended for Bore, Ana Sorra, Dama and similar agro ecologies of Guji Zone for production and scaling up programs. In general involving famers in research, specially, in crop breeding can improve variety development as the famers are capable of identifying superior lines that meet their specific require

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