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Performance Evaluation of Field Pea (*Pisum sativum* L.) Varieties in Buno Bedele Zone, South-Western Oromia, Ethiopia

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Abstract

Field pea (*Pisum sativum* L.) is one of the leguminous crops that are rich in protein and essential amino acids. A field experiment was conducted during the 2021- 2023 cropping season consisting of eight (Arjo-1, Bilalo, Bursa, Dadimu, Gedo-1, Herena, Hortu and Weyib) improved field pea varieties and one local variety at Buno Bedele zone south western Oromia region to identify high yielding varieties. The experiment was carried out using a randomized complete block design with three replications at locations (Dabo Hana and Bedele). Data on yield and yield-related traits such as Days to flowering, Days to maturity, Plant height, number of pod per plant, number of seed per pods, and grain yield were recorded. Combined ANOVA over two locations revealed significant differences among varieties for days to flowering, days to maturity and number of seed per plant and non-significant for plant height, number of pod per plant and grain yield. However, the combined mean of grain yield of varieties indicated that Bursa (1542.10kg ha^{-1}) and Bilalo (1540.46kg ha^{-1}) varieties had the highest grain yield advantage over the other tested varieties without significant difference among the order, whereas Gedo-1 (1186.91kg ha^{-1}) Arjo-1 (1287.79kg ha^{-1}) and Woyib (1403.29kg ha^{-1}) and local (1041.41kg ha^{-1}) varieties manifested low grain yield. Generally, it is better if the work is repeated in the future for more justification since it was non-significant for grain yield before recommending the varieties for large scale production at the studied area.

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Keywords

Varieties, Field pea, RCBD, ANOVA and Experiment.

Introduction

Field pea (*Pisum sativum* L.) is a self-pollinated diploid ($2n=14$) annual cool-season pulse and major food legume with a valuable and cheap source of protein having essential amino acids that have high nutritional value for resource-poor households (Nawab, 2008; Getachew, 2019). The crop has the potential of growing in variable ranges of altitudes from 1450-3200 m.a.s.l, where the annual rainfall is in the ranges of 400-1000mm. 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 (Fikere *et al.*, 2014; Muoni *et al.*, 2019). 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 average yield productivity of 1.71 t/ha in Ethiopia (CSA, 2021).

Despite its importance, the average national productivity (1.7 t/ha) is very low (CSA, 2021) when compared with the crop potential yield (3.556 t/ha) and (4.17 t/ha) research finding in Ethiopia reported by Tolasa *et al.*, (2013) and Mogiso (2017) respectively and the higher yielder (7-8 t/ha) reported at some European countries

(Smykal *et al.*, 2012), this is due to very limited availability of improved seeds and most pulse crops are grown from unimproved cultivars with low genetic potential. In contrast to the release of many improved pulse varieties which are adapted to a wide of rainfall, soil, and altitude regimes, the use of certified improved seeds by farmers is very low (Boere *et al.*, 2015; Mogiso, 2017). Because, availability of quality seed of improved field pea varieties at sufficient quantity is one of the major constraints to increase productivity (Ali *et al.*, 2021). Since developing a variety takes a long time, as an immediate solution it is recommended to provide the seed of existing improved varieties to the farmers (Tariku *et al.*, 2020). Even though Buno Bedele is a potential area for field pea production, field pea producers in the area cannot afford improved variety as other cereal crops. Therefore, the study was initiated to select higher yield improved field pea varieties for the Buno Bedele zone farming community and other similar agro-ecology areas. The result of this finding gives valuable information for field pea producers and it also gives direction for researchers and field pea breeders to focus on genotype by environment interaction, while releasing improved variety.

Materials and Methods

Description of the study Areas

The field experiment was conducted during the 2021 – 2023 G.C main cropping seasons at two districts (Bedele & Dabo Hana) of Buno Bedele Zone, South Western Oromia where agro ecology assumed to be conducive for Field pea production (Table 1).

Experimental Materials

Eight (8) improved field pea varieties from different Research Centers, and one local check from farmers, were collected and evaluated for performance and variability over seasons (Table 2).

Experimental Design and Field Work

The treatments were laid with a randomized completed block design (RCBD) with three replications was used in the study. The experimental plots were 1.8 m × 3 m (7.4m²) in size, with rows separated by 0.3m. The distance between plots and blocks was 0.5 m and 1m, respectively. Each plot had six rows, with the middle four used for the collection of the data and the two outermost rows were used as border rows. The

experimental sites were plowed three times with draught animals called oxen before planting, and 80 kg ha⁻¹ seed rate and 100 kg ha⁻¹ of NPS fertilizer rate were used according to crop recommendations.

Data Collection

Data on flowering days, maturity days, number of pods per plant, number of seeds per pod, plant height, and seed yield per plot were collected from the four middle rows.

Days to flowering - were calculated from the date of planting when 75% of the crop stand produced the first flower.

Days to maturity - The number of days from planting to physiological maturity of the plants was used to compute the days to maturity.

Plant height - The average height of five randomly selected plants, measured from the base to the tip of the plant.

The number of pods per plant - was recorded as the average number of pods from five randomly sampled plants taken from the four middle rows of the plots

The number of seeds per plant - It was calculated as the mean number of seeds collected from five randomly selected from the four middle rows of the plots.

Seed yield (kg plot⁻¹) - It was calculated as the entire seed yield produced from the plants harvested and threshed and converted into seed yield per hectare.

Data Analysis

The analysis of variance (ANOVA) for each location and combined analysis of variance over locations were performed using the R program and the mean separation was done using Least Significant Difference (LSD) at the 5% probability level.

Results and Discussion

Analysis of variance (ANOVA)

The combined analysis of variance over the two locations revealed significant differences for days to flowering, days to maturity and number of seed per pod and non-significant for yield, plant height and number of

pod per plant among the tested varieties (Table 3 & 4). This may be due to the genetic composition of the tested varieties. The analysis of variance also revealed non-significant differences among the tested varieties,

locations, and varieties into environmental interaction for grain yield. This indicates that the tested locations have almost similar potential for field pea crop production based on their agro-climatic characters.

Table.1 Agro-ecological features of the experimental Locations

Locations	Altitude(m.a.s.l)	R/fall (mm)	Soil Type	Geographical Coordinates		Ave. Temperature (°C)	
				Latitude N	Longitude E	Max.	Min.
Bedele	1300-2200	1200-1800	Nitosols	8°28'60.00"	36°20'60.00"	28.5	12.5
Dabo Hana	1791-1990	1300-1945	Nitosols	8°55'60 20"	36°26' 19.00"	25.8	12.9

Table.2 Description of the field pea (*Pisum sativum* L.) varieties used in the experiment.

Varieties	Year of release	Releasing center/Maintainer	Seed size
Arjo-1	2005	BARC/OARI	Medium
Bilalo	2012	KARC/EIAR	Medium
Bursa	2015	KARC/EIAR	Medium
Dadimu	1995	SARC/OARI	Medium
Gedo-1	2010	BARC/OARI	Medium
Harana	2012	KARC/EIAR	Medium
Hortu	2012	KARC/EIAR	Medium
Woyib	2017	SARC/OARI	Medium
Local	-	Farmers	Medium

Remark: KARC=Kulumsa Agricultural Research Center, BARC=Bako Agricultural Research Center, SARC=Sinana Agricultural Research Center, EIAR=Ethiopia Institute of Agricultural Research & OARI=Oromia Agricultural Research Institute

Table.3 Combined mean yield related traits of nine (9) *Field pea* varieties over two years at Dabo Hana and Bedele districts, Buno Bedele Zone for three years.

Varieties	DTF (days)	DTM (days)	PLH (cm)	NP/PL	NS/P
Arjo-1	59.44 ^a	102.78 ^{ab}	111.15	8.85	4.52 ^{ab}
Bilalo	66.78 ^a	99.00 ^{abc}	124.56	9.08	4.17 ^{ab}
Bursa	66.44 ^a	103.78 ^{ab}	124.15	8.22	4.37 ^{ab}
Dadimu	68.67 ^a	99.00 ^{abc}	112.19	8.44	3.91 ^b
Gedo-1	66.56 ^a	105.33 ^a	110.96	9.37	4.07 ^{ab}
Harana	64.78 ^{ab}	91.33 ^d	106.85	9.07	4.81 ^a
Hortu	68.22 ^a	97.78 ^{bcd}	108.37	9.63	4.52 ^{ab}
Woyib	66.22 ^a	96.00 ^{cd}	123.85	8.93	4.32 ^{ab}
Local	58.67 ^a	102.22 ^{abc}	109.78	9.37	4.78 ^a
GM	65.09	99.69	114.65	8.99	4.38
LSD (0.05)	6.43	6.69	26.94	4.60	0.78
CV %	10.51	7.13	24.99	54.44	18.85
P-value	*	**	NS	NS	*

*Remark: DTF= Days to Flowering, DTM= Days to Maturity, PLH= Plant height (cm), NP/PL= Number of pod per plant, NS/P= Number of seed per Pod, GM= Grand mean, LSD= Least significant different, CV= Coefficient of variation, NS= Non-significant, *=significant at P<0.05 level, **=very significant significant*

Table.4 Combined mean grain yield (kg ha^{-1}) of nine (9) *Field pea* varieties tested at Dabo Hana and Bedele districts for three years (2021-2023)

Varieties	D/Hana-2021	Bedele-2022	Bedele-2023	Comb.	Over All	Yld Adv.
Arjo-1	1444.33 ^c	2337.96 ^a	81.08 ^{bc}	1209.52	1287.79	23.66
Bilalo	2771.67 ^a	1773.15 ^{ab}	76.58 ^{bc}	924.86	1540.46	47.92
Bursa	2321.00 ^{ac}	2212.96 ^{ab}	92.34 ^{abc}	1152.65	1542.10	48.08
Dadimu	1944.33 ^{abc}	2162.04 ^{ab}	135.14 ^{ab}	1148.59	1413.84	35.74
Gedo-1	1888.67 ^{abc}	1615.74 ^{ab}	56.31 ^c	836.02	1186.91	13.97
Harana	2518.67 ^{ab}	1937.96 ^{ab}	94.59 ^{abc}	1016.28	1517.08	45.68
Hortu	2160.67 ^{abc}	2105.56 ^{ab}	99.10 ^{abc}	1102.33	1455.11	39.72
Woyib	1802.33 ^{bc}	2245.37 ^a	162.16 ^a	1203.77	1403.29	34.75
Local	1815.00 ^{bc}	1241.67 ^b	67.57 ^{bc}	654.62	1041.41	-
GM	2074.07	1959.16	96.0961	1027.63	1376.44	
LSD (0.05)	949.15	989.33	74.64469	1300.91	1017.07	
CV %	26.44	29.17	44.87685	108.73	78.59	
P-value	*	*	*	NS	NS	

Remark: GM= grand mean, LSD=least significant difference, CV= coefficient of variation, *= significant, NS=Non-significant

Conclusions and Recommendations

Based on the present find all tested varieties showed non-significant difference in terms of yield across the two locations and three years. Finally, to recommend the best varieties in the studied area yield stability analysis of the varieties is advisable and this work should be repeated in the future for more justification. Since seed yield with all varieties showed non-significant, farmers in the study area can use all varieties tested but we recommended more to use Bursa and Bilalo varieties to be demonstrated on farmer’s field for further scaling up.

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