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Adaptability study of Cowpea [*Vigna unguiculata* (L) Walp.] varieties in Pastoral areas of South Omo Zone, Southern Ethiopia

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A B S T R A C T

Field experiments were conducted on pastoral and agro-pastoral areas of South Omo Zone at Dasenech, Hammer and Gynagatom woredas of South Omo Zone, Southern Ethiopia on four cowpea [*Vigna unguiculata* (L) Walp.] varieties in 2019 under irrigation. The objective of the study was to select the best performing cowpea varieties in the target areas. The cowpea varieties included in the field experiment were (Black eye bean, Bole, TVU, and Kankeit). The experiments were carried out using a randomized complete block design (RCBD) with three replications. The combined analysis of variance results depicted that there were significant differences among the varieties for all the studied parameters except the number of seeds per pod. The mean values for plant height ranged from 84.89 (cm) for the variety Bole to 120.67 (cm) for TVU. The mean values for the number of pods per plant ranged from 24.33 for the variety Bole to 46.90 for TVU. The mean value for 100 seeds weight was maximum (21.11g) for the cowpea variety black eye bean and, while it was minimum (17.11 g) for the variety TVU. The highest overall mean grain yield of 2457.0 kg ha^{-1} was recorded for the variety Kankeit while the minimum 1695.3 kg ha^{-1} was noted for the cowpea variety black eye bean. Therefore, the variety Kankeit and TVU could be recommended for the study areas however further research should be done to put the recommendation on a strong basis.

Keywords: Cowpea, Varieties, Yield components, Grain Yield

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Introduction

Pulses have been acknowledged as a key source of proteins (20 to 35%) with essential minerals and vitamins (Fall *et al.,* 2003; Girma *et al.,* 2005). Cowpea [*Vigna unguiculata* (L.) Walp.], is a dicotyledonous plant belonging to the family Fabaceae and sub-family, Fabiodeae (Agbogidi, 2010).

Cowpea is a multipurpose crop; the entire plant can be used for either human or livestock consumption. Its major importance is to the livelihoods of millions of relatively poor people in less developed countries of the tropics. As suggested by Islam *et al.* (2006), all parts of the plant are used as food, which is nutritious providing protein and vitamins. Immature pods and seeds are used as vegetables while several snacks and main dishes are prepared from the grains (Pottorff *et al.,* 2012). Cowpea grain contains about 25% protein and 64% carbohydrate and therefore has a tremendous potential to contribute to the alleviation of malnutrition among resource-poor farmers and can be used as animal feed and cash income. Its young leaves, pods and seeds contain vitamins and minerals, which have fuelled its usage for human consumption and animal feeding and the scorched seeds are occasionally used as a coffee substitute (Ogbemudia *et al.,* 2010). As reported by Ayana *et al.* (2013) integration of cowpea with the prevailing farming system using native cowpea variety could have significant importance in improving soil fertility and productivity, improving feed quality and withstands the impact of climate change.

It is an annual legume grown throughout the semi-arid tropics, where it is valued and potential to produce high levels of fodder for livestock in addition to grain for people. Its dual-purpose character, weeds suppressing ability, positive impact on soil properties, drought tolerance and

being a warm-weather crop makes cowpea an attractive and promising forage species in a typical tropical lowland climate. It is usually better adapted to drought, high temperatures and other biotic stresses than other crop plant species (Hall *et al.*, 2002; Tessema and Eshetayehu, 2006).

Drought stress related to climate change is a more challenge for enhancing agricultural productivity for resource-poor farmers. Cowpea is one of the dry land grain legumes for overcoming drought-related problems. Therefore, there is a need to introduce these improved cowpea varieties to moisture stress areas of the South Omo Zone under irrigation.

Materials and Methods

Description of the study area

The adaptive research was implemented in Dasenech, Hammer, and Nyangatom woredas of South Omo zone, Southern Nations, Nationalities, and Peoples Regional State. Geographically, these three administrative districts are found in the southwestern part of Ethiopia, located at about 981, 801, and 971 Kilometers, respectively from the capital (Addis Ababa). Astronomically, Dasenech woreda (administrative district) found lying between 4°37′–4°48′ N latitude and 35°56′–36°20′ E longitude, Hammer between 4°25′–5°30′ N latitude and 36°5′–36°59′ E longitude and Nyangatom between 5°05′–5°21′ North latitude and 35°55′–36°14′ East longitude, respectively. The altitude of the areas varies between 353 m.a.s.l and 606 m.a.s.l for Dasenech, 371 m.a.s.l. and 2084 m.a.s.l for Hammer and 380 m.a.s.l and 497 m.a.s.l for Nyangatom district, respectively.

Treatments and experimental design

The experiment consisted of four improved cowpea varieties with a total of 12 plots. The field experiment was laid out in a randomized complete block design (RCBD) with three replications. Cowpea was sown in ten rows per plot with a spacing of 60 cm between rows and 20 cm between plants within a row with a gross plot area of (6 m x 5 m= 30 m^2).

Data collection

Grain yield

Six central rows (5.0 m x 3.6 m = 18 m^2) were harvested for the determination of grain yield. Grain yield was adjusted to 12.5% moisture content. Ten plants were randomly selected from the six central rows to determine yield and yield components, which consisted of plant height, number of pods per plant, and number of seeds per pod.

Data analysis

All the agronomic data were recorded and being subjected to analysis using the R statistical Software Version 3.4.1. Effects were considered significant in all statistical calculations if the P-values were $\leq$ 0.05. Means were separated using Fisher's least significant difference (LSD) test.

Results and Discussion

According to the combined analysis of variance results, there were significant differences observed among the cowpea varieties for plant height, pods per plant, 100 seed weight and grain yield but no significant difference was observed among the varieties for the number of seeds per pod (Table 1). This finding is in agreement with the previous works of Tekle (2014); Gereziher *et al.* (2018) who reported that there were significant variations observed among the cowpea varieties for yield and yield-related traits.

Pant height ranged from 69 (cm) for the variety Bole at Dasenech to 159 (cm) for the variety TVU at Gynagatom (Table 3). The results revealed that the mean values for plant height ranged from 84.89 (cm) for the variety Bole to 120.67 (cm) for TVU across locations (Table 2). The maximum number of pods per plant (69) was recorded for the variety TVU at Gnangatom, while the minimum (21) was noted for the variety Bole at Hammer (Table 3). The combined analysis of variance results depicted that the mean values for the number of pods per plant ranged from (24.33) for the variety Bole to (46.90) for the variety TVU (Table 2). Though no significant differences were observed among the varieties for the number of seeds per pod, the maximum number of seeds per pod (20) was obtained for the variety Kankeit at Dasenech, while the minimum (14) was recorded from the variety Bole at Gnangatom (Table 3). The combined analysis of variance result depicted that the mean values for the number of seeds per pod ranged from (16.67) for the variety Bole to (17.89) for the varieties Kankeit and TVU (Table 3). The values for 100 seed weight in gram (g) ranged from (9) for the variety TVU at Gnangatom to (26) for the variety Kankeit at Dasenech. The results also showed that the overall mean values for the hundred seed weight ranged from 17.11 (g) for the variety TVU to 21.11 (g) for the variety black eye bean (Table 3).

The combined analysis of variance results revealed that there were significant differences observed among the cowpea varieties for grain yield (Table 1). The combined analysis of variance results showed that the overall mean values for grain yield ranged from 1695.3 kg ha^{-1} for the variety black eye bean to 2457.0 kg ha^{-1} for the variety Kankeit (Table 2). The values for grain yield ranged from 1485 kg ha^{-1} for the variety black eye bean at Hammer to 2587 kg ha^{-1} for the variety Kankeit at Dasenech (Table 3).

Table 1. Mean square values for growth parameters, yield components and grain yield of cowpea at south omo zone in 2019.

Source of Variations	DF	PH	PPP	SPP	HSW	GY
Rep	2	529.08*	206.18*	0.03*	0.58*	28300*
Variety	3	2456.11**	935.08***	3.29ns	32.18**	929740***
Location	2	27.33 ns	56.78ns	0.03ns	0.25ns	25871ns
Location x Variety	6	214.11ns	44.93ns	1.88ns	2.51ns	26498ns
Error	22	392.51	56.67	6.15	5.79	84595

*Note: *, ** and *** indicate significance at P ≤ 0.05, P ≤ 0.01 and P ≤ 0.001, respectively and 'ns' indicate non-significant, DF= degree of freedom, PH= plant height (cm), PPP= the number of pods per plant, SPP= the number of seeds per pod, HSW= 100 seeds weight (g) GY= Grain Yield (kg ha^{-1}).*

Table 2. combined results of mean values of growth parameters, yield components and grain yield of cowpea varieties at south omo zone, in 2019.

Varieties	PH	PPP	SPP	HSW	GY
Cankeit	118.89a	27.01b	17.89a	20.22ab	2457.0a
TVU	120.67a	46.90a	17.89a	17.11b	2042.0b
Bole	84.89b	24.33b	16.67a	17.89b	1905.3b
BEB	110.89a	29.54b	17.11a	21.11a	1695.3b
Mean	108.83	31.95	17.39	19.08	2024.9
CV (%)	18.20	23.56	14.26	12.62	14.36
LSD (0.05)	25.94	9.86	3.25	3.15	380.79

Note: PH= plant height (cm), PPP= number of pods per plant, SPP= number of seeds per pod, TSW= 1000 seeds weight (g), GY= Grain Yield (kg ha^{-1}).

Table 3. Mean values for the studied yield and yield component traits of four cowpea varieties at dasenech, hammer and gynagatom, south omo zone in 2019.

Variety	PH (cm)				PPP				SPP				HSW (g)				GY (kg ha^{-1})			
	Location				Location				Location				Location				Location			
	Dasenech	Hammer	Gynagatom	Mean	Dasenech	Hammer	Gynagatom	Mean	Dasenech	Hammer	Gynagatom	Mean	Dasenech	Hammer	Gynagatom	Mean	Dasenech	Hammer	Gynagatom	Mean
Cankeit	102	103	147	134	49	26	27	34	20	21	16	19	21	26	13	20	2443	2587	2094	2375
TVU	110	103	159	135	32	23	63.3	39	18	18	20	19	17	16	9	14	1781	2361	2110	2084
Bole	69	91	86	91	26	21	21.7	23	16	16	14	16	22	19	17	19	1776	1552	2143	1824
BEB	102	103	119	115	21	22	51.7	31	15	15	19	16	21	20	18	20	1641	1795	1485	1640
CV (%)	7	8	15	16	19	13	5.6	12	11	10	13	11	4	14	15	11	17	17	13	16
$LSD_{(0.05)}$	11	16	38	25	10	6	4.6	7	NS	NS	NS	NS	1	6	2	3	544	702	495	580

Note: PH= plant height (cm), PPP= number of pods per plant, SPP= 1number of seeds per pod, HSW= 100 seed weight (g), GY= grain yield (kg ha^{-1}).

Summary and Recommendation

Production of cowpea by introducing the improved and high yielding varieties is an important contribution to increase agricultural production and productivity in areas like Dasenech, Gyngatom and Hammer woredas where there is the low practice of using improved varieties of cowpea. To this end, using the improved cowpea varieties could be one of the alternatives to improve productivity by small farmers. However, the production of cowpea using the improved varieties is not yet introduced and studied in the target area. Thus, this research work is initiated to investigate the impact of improved varieties on the performance of cowpea.

A study on variety was conducted at Dasenech, Gyngatom, and Hammer under irrigated conditions in 2019. The objective of the study was to select the best performing varieties that will improve cowpea production. The experiment was carried out using the randomized complete block design (RCBD) with three replications at Dasenech, Gyngatom and Hammer under irrigated conditions in 2019. The treatments involved in this experiment were four improved

cowpea varieties. The results of the analysis of variance showed that all the studied were significantly affected by varieties. In this study, there were significant variations observed among the cowpea varieties for all the yield and yield components.

The highest overall mean grain yield of 2457.0 kg ha^{-1} and 2042.0 kg ha^{-1} were recorded for the varieties Cankeit and TVU, respectively while the minimum 1695.3 kg ha^{-1} was noted for the cowpea variety black eye bean. Therefore, the cowpea variety Kankeit and TVU could be recommended for the study areas however further research should be done to put the recommendation on a strong basis.

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