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Research Article

Adaptation and Yield Performance of Different Cowpea (*Vigna unguiculata L.*) Varieties in Western Gojjam, Ethiopia

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Abstract: Field experiment was conducted during 2013/14 rainy season in two selected districts of north western Ethiopia with the objective of evaluate the adaptability and yield performance of cowpea (*Vigna unguiculata*) varieties under sole cropping. Treatments consisted of seven cowpea (TVU, Bekur, 9333, 9334, 12688, Kenkety and Black eye bean) varieties in randomized complete block design with three replication per district. Variety showed highly significance difference in their Dry Matter Yield (DMY) and the value ranged 2.07 to 4.19 t/ha. Cowpea variety 9334 showed highly significance (4.19) difference in its DMY as compared to12688 (3.09), black eye bean (2.85), TVU (2.79) and bekur (2.07t/ha). Seed yield also showed highly significance difference by variety and district. Cowpea variety 9333 gave significantly higher (1235.4kg/ha) seed yield compared to TVU (733.3), 9334 (722.9), black eye bean (511.8) and bekur 487.5 kg/ha. There was also significant variation between the number of seeds per pod obtained from kenkety and 12688 with that of most cowpea varieties. Black eye bean significantly differed from all cowpea varieties evaluated in its thousand seed weight. Based on yield data kenkety 9333 and 9334 recommended as alternative legume forage crops from cowpea varieties evaluated under sole cropping for Jabitehnan and South Achefer areas.

Keywords: Districts, dry matter yield, legume forage crop, seed yield, sole cropping

INTRODUCTION

Feed scarcity in qualitative and quantitative dimensions is one of the major impediments to livestock production in Ethiopia. The quality and quantity of feed resources available to the animals in most parts of the country is mainly affected by seasonal fluctuation of rainfall. Sileshi and Bediye (1989) reported that the Crude Protein (CP) and Metabolizable Energy (ME) content of natural pasture showed seasonal variations which correspond closely to the seasonal pattern of rainfall. According to the results reported by same author's peak CP and ME content of 11.2% and 8.2 MJ/kg observed in July declined steadily to 3.3% and 7.1MJ/kg in March. In contrast, Neutral Detergent Fiber (NDF) content increased from 61% in July to its peak of 80% in March. This shows that during the long dry season, animals are prone to nutritional deficiency and need to be supplemented.

Much of the available feed resources are derived from fragmented native pastures, transient pastures between cropping cycles, crop residues and crop aftermath. Feed supplies are constrained mainly by shrinkage of grazing land; decline in soil fertility and by the unreliable seasonal rainfall pattern in mixed crop-livestock producing areas of Ethiopia (Mengistu, 2002). Tolera and Abebe (2007) reported in the pastoral and agro pastoral production system of Southern Ethiopia, the available feed resources are characterized by marked seasonal variation in availability and quality based on variability of rainfall there by productivity of animals in terms of milk production, growth rate and reproductive performance is generally low. Moreover, Reasonable levels of increases in body weight of animals gained during the wet season are lost dramatically during the long dry season (Woldegiorgis, 2014). Limitation of land for food crop production is also another problem in the area (WOARD, 2003). Similarly, scarcity of grazing land and livestock feed shortage are critically sever in the study districts. Keeping in mind efficient utilization of locally available feed resources, there has to be means of introducing forage production in to the existing farming system so that both crop and livestock production can

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supplement each other (Mengistu, 2002). Therefore, to minimize these problems introducing multipurpose forage crops like cowpea in the area is one option.

Cowpea is short lived annual legume that can best be inter-cropped with cereals like maize and sorghum (Jerany, 1998). In addition to its suitability for inter-cropping, crop residue (hay and haulm) from cowpea is a very important fodder resource, which contains higher crud protein content which is about 21% in the dry haulm (Singh and Tarawali, 1997). In addition to its food and forage value, it is very important in improving soil fertility through the process of atmospheric nitrogen fixation.

With all the above mentioned advantages, cowpea can be a potential forage and food crop around West Gojjam that could be easily adopted by farmers. However, there are no recommended/introduced varieties of cowpea for the area. Thus, this cowpea adaptation trial was conducted to find a multipurpose, adaptive and productive cowpea variety for the study areas.

MATERIALS AND METHODS

Study area: The study was conducted at South Achefer and Jabitehnan districts of West Gojjam zone, Amhara Region. In South Achefer district, the altitude ranges between1500 and 2600 meters above sea level. It lies between 9^0 23' to 9^0 26' latitude and 41^0 59' to 42^0 02'E longitude. The study area is characterized by a mono-modal rainfall pattern and receives an annual rainfall of 1365-1623 mm with irregular and heavy in some months. The daily temperature ranges from 18 to 27°C, with mean minimum and maximum temperatures, respectively. On the other hand, in Jabitehnan district the altitude ranges between 1500 and 2300 meters above sea level and characterized by a mono-modal rainfall pattern and receives a mean annual rainfall of 1250 mm. The daily temperature ranges from 14 to 32°C, with mean minimum and maximum temperatures, respectively (WOARD, 2003).

Experimental design, treatments and planting: Seven cowpea varieties (TVU, Bekur, 9333,9334, 12688, Kenkety and Black eye bean) as pure stand were used for the experiment. Two voluntary Farmers Training Center (FTC) were selected and 13m x 36m land was finely ploughed and prepared from each FTC. Net plot size was $12m^2$ (3×4 m). The design was Randomized Complete Block Design (RCBD) with three replications. Planting time was at the onset of the main rainy season. Each cow pea variety randomly assigned to block. Spacing 30 cm between rows and 10cm between plants with two seeds per hole and thinned to one after two weeks for proper plant growth. Each plot consisted of 10 rows. Spacing for both between replication and between plots was 1m. Seed rate of 20-25 kg/ha and DAP fertilizer 100 kg/ha were used during planting.

Data Collection and data analysis: Each plot was divided in to two halves. The middle two rows of the first half plot were harvested at 50% flowering for forage dry matter yield estimation where as the middle two rows of the second half plot were harvested at physiological maturity for grain yield estimation. The fresh biomass harvested was dried until constant weight. Ten plants were randomly selected and pod per plant and seed per pod were taken as average of this ten plants. Since cowpea pod do not mature uniformly in the experiment, two times harvesting were done and collected and dried in sun light. Seed yield data was taken after proper drying and weighed using sensitive balance. Finally, the collected data were analyzed using the General Linear Model procedure of Statistical Analysis Soft ware (SAS, 2002).

RESULTS AND DISCUSSION

Herbage dry matter yield: Summary of the Mean Dry Matter Yield (DMY) for the different cowpea varieties across year is presented in (Table 1). Variety showed highly significance difference ($p<0.001$) in DMY and the value ranged from 2.07 to 4.19 (tha^{-1}). Cowpea variety 9334 showed highly significance (4.19) difference ($p<0.001$) as compared to black eye bean (2.85), 12688 (3.09), TVU (2.79) and bekur (2.07t/ha) but no significance difference ($p>0.05$) was observed with that of kenkety (3.33) and 9333 (3.28 t/ha).The study also revealed that cowpea variety bekur (2.07 tha^{-1}) gave the lowest dry matter yield compared to seven cowpea varieties evaluated (Table 1). Results showed that there was no significance difference ($p>0.05$) between districts in their DMY.

Cowpea seed yield, pod per plant, seed per pod and thousand seed weight: Cowpea seed yield, pod per plant, seed per pod and thousand seed weight are presented in Table 1. Seed yield showed highly significance difference ($p<0.0001$) by variety and district. Cowpea variety 9333 gave significantly higher (1235.4$kgha^{-1}$) seed yield compared to TVU (733.3), 9334 (722.9), black eye bean (511.8) and bekur 487.5 kg/ha but no significance difference ($p>0.05$) was observed with cowpea varieties kenkety (1008.3) and 12688 (1106.7 $kgha^{-1}$). Similarly 9333 gave significantly higher pod/plant compare to most cowpea varieties. There was also significant variation between the number of seeds per pod obtained from varieties kenkety and 12688 compared to that of the other cowpea varieties. Black eye bean significantly differed from all cowpea varieties evaluated in its thousand seed weight. Results showed that there was highly significant ($P<0.0001$) variation between districts in

Table 1: Dry matter yield (tha^{-1}), seed yield ($kgha^{-1}$), pod per plant, seed per pod and thousand seed weight of cowpea varieties under sole cropping system in South Achefer and Jabitehnan districts, Ethiopia

Variables	N	DMY tha^{-1}	SY $kgha^{-1}$	Pod/plant	Seed/pod	1000swt
Overall		3.09	829.4	5.6	8.95	0.12
SE		0.34	126.97	0.65	0.46	0.01
CV		17	17.5	18	12.6	10.2
Variety		**	***	*	***	***
Kenkety	6	3.33ab	1008.3ab	5.06b	11.17a	0.13b
9334	6	4.19a	722.9bc	4.65b	8.45c	0.11c
9333	6	3.28ab	1235.4a	5.60ab	9.25bc	0.12c
Black eye bean	6	2.85bc	511.8c	5.53ab	7.98cd	0.15a
TVU	6	2.79bc	733.3bc	7.34a	8.48c	0.10d
12688	6	3.09b	1106.7a	6.07ab	10.35ab	0.14ab
Bekur	6	2.07c	487.5c	5.25b	6.95d	0.11c
District		ns	***	ns	ns	*
SE		0.18	67.87	0.35	0.25	0.003
South Achefer	21	3.13	1145.4a	5.94	9.14	0.13a
Jabitehnan	21	3.05	513.4b	5.34	8.75	0.12b

[a-d]: Means within the same column bearing different superscript differ significantly SL, significance level;* = (P<0.05); ** = (P<0.01); *** = (p<0.0001); N, number of observation DMY, dry matter yield; SY, seed yield; SE, standard error of mean; CV, coefficient of variation

their seed yield. South Achefer (1145.4) district gave significantly higher seed yield as compared to Jabitehnan (513.4 $kgha^{-1}$). This might be variation in annual rainfall and temperature that can favour the photosynthesis rate of the Varieties for better grain filling stage. The mean minimum and maximum temperature variation is higher in Jabitehnan than South Achefer which could be favourable for cowpea grain filling in the second district. Moreover, the incidence of fusarium wilt is slightly higher in Jabitehnan which could contribute to seed yield differences.

Unlike to the present study Yeheyis (2006) reported there is no significant difference among the six cowpea varieties in forage, haulm and grain yield for the two-year combined data analysis in Shewa Robit, North shewa zone, Ethiopia. Moreover, Singh *et al*. (2011) reported variety had no significant effect on the grain yield in the Sudan savanna of Nigeria and the value ranged 1120 and 1074kg/ha. The author suggest that the reason might be attributed to small number of varieties used in Nigeria condition while seven varieties used in the present study. The yield difference in Shewarobit, North shewa as compared to the present study might be due to difference in cowpea varieties used, climatic condition such as annual temperature and rainfall variation and soil fertility difference which could have greater impact in crop yield. Even though, variety has significant effect on seed yield in the present study the yield was comparable to Singh *et al*. (2011). Similarly 100 seed weight had no significant effect in the Sudan savanna of Nigeria but in the present study highly significant difference was observed between varieties in their thousand seed weight.The results indicated that cowpea variety black eye bean had significantly the heaviest grains but significantly the lowest grain yields compared with the rest of the varieties.

Incidence of disease: The disease observed in the present study might be Fusarium wilt or Cowpea wilt (*Fusarium oxysporum)*. Its occurrence first observed during middle of August when there was high rainfall and relatively moderate temperature. At this particular time cowpea was in its flowering stage. As the intensity of rainfall declines and temperature rises the stems starts new shoots and moderately recover. The symptoms observed was yellowing and leaf drooping in the leaves, shoots dry and stem became wilt. The incidence was slightly higher in Jabitehnan as compared to South Achefer districts. In India the yield loss caused by the fungus recorded 26.8 to 64.5% (Singh and Sinha, 1955).

CONCLUSION

Cowpea varieties 9334, kenkety and 9333 in their forage dry matter yield and 9333, 12688 and kekety in their seed yield gave better yield in their orders. Based on yield data 9334, kenkety and 9333 recommended as alternative legume forage crops from cowpea varieties under sole cropping for Jabitehnan and South Achefer areas. Future study should focuses on identification of cause of disease and preventive measure of the diseases for wider adoption in the study districts and other similar agro ecologies.

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Conflict of interest: Cowpea is dual purpose crop in Ethiopia. This makes conflict of interest as human and livestock feed.

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