Research Article **AJAR (2019), 4:30**

American Journal of Agricultural Research (ISSN:2475-2002)

Effect of between plants space on Seed yield potential of cow pea at Dilla sub- station, Southern Ethiopia

Worku B Margia A. and Bangu B

Hawassa agricultural research center, livestock Research work process, P.O. box 2126 Hawasssa

ABSTRACT

The study was conducted in Dilla substation with objective of identifying optimum between plant space for optimum seed yield and quality seed. Planting one high yielding which is in seed multiplication status was used as experimental material. Four different between plant space(10 cm, 20cm, 30cm and 40cm with constant between row space(40cm) were used as experimental treatments in a randomized complete block design (RCBD) with four replications. Plot size was 3 x 2m with an inter-row spacing of 40cm and 1m between replication and plots. Dry matter herbage yield has shown significantly higher in between plant space of 20cm than other treatments (30 and 40 cm) at ($p<0.05$) which is in contrary to seed yield. Seed yield has showed statistically significant variation at 30cm than at 20 and 10 cm between plants spaces at ($p<0.05$). Hence, there will be two recommendation options for smallholder producers. To secure feed shortage and increased herbage production 20cm between plant space where as increased seed yield and further researches spacing under intercropping condition in different cereal crops should be conducted to fill the existing knowledge gap and thereby to utilize efficiently existing resources and plaster feed shortage gap.

***Correspondence to Author:**
Worku B Margia A.
Hawassa agricultural research center, livestock Research work process, P.O. box 2126 Hawasssa

How to cite this article:
Worku B Margia A. and Bangu B. Effect of between plants space on Seed yield potential of cow pea at Dilla sub- station, Southern Ethiopia. American Journal of Agricultural Research, 2019,4:30.

eSciPub LLC, Houston, TX USA.
Website: http://escipub.com/

Introduction

Feed shortage both in quantity and quality remains the leading constraint to good animal performance in Ethiopia (Yayneshet et al 2009). Natural pasture and crop residues are the main feed sources. However, most of the feedstuffs obtained from natural pasture and crop residues have crude protein (CP) levels below 8% and neutral detergent fiber (NDF) of above 55% (Seyoum and Zinash 1995). Feedstuffs of such composition are insufficient to provide year round supply of adequate quantity and quality of nutrients beyond maintenance (Hindrichsen et al 2001). Various options have been advocated Cowpea is well adapted to the harsh growing conditions, including low soil fertility, high temperatures, and drought (Turk et al 1980). Cowpea can fix nitrogen to improve soil fertility and cropping system productivity. Additionally, farmers feed cowpea fodder to livestock to increase income, and collect the manure produced for use in their fields thereby reduces farmers' reliance on commercial fertilizers and sustains soil fertility (Odion et al 2007; Akinlade et al 2005). Previous studies with cow pea (Gwanzura et al 2012; Akinlade et al 2005; Ebro et al 2004; Alemayehu 1997) indicated this legume improves soil fertility and enhances the intake and utilization of poor quality roughage consequently improves livestock production and productivity. Another important feature of cowpea is also its ability to suppress weeds particularly Striga species (Dawit et al 2009) as possible solutions to this perennial problem. This includes feeding of treated and, untreated crop residues or integration of forage legumes into the feeding strategies. Legumes are the most important forage plants that substantially improve the feed available for livestock as they can provide the essential protein for animals, improving soil fertility, food crop production and household nutrition through a more reliable supply of milk and meat (Akinlade et al 2005; Alemayehu 1997).

In the Southern region demand for production of improved forage production is increasing due to decreasing trend of grazing land for livestock production and increased awareness of farmers on improved forage production by different stalk holders (unpublished AGP-II need assessment, 2016 report). However, supply of improved forage crop seed is below the demand, this is mainly due to lack of forage production enterprises, lack of forage seed production bylaw and there is no seed rate space that is recommended for seed production despite of presence of manual for forage herbage production. Hence, identifying optimum seed yield production space rather than herbage will encourage seed producers which in turn has significant importance in improving feed quality and soil fertility and productivity. Therefore, this experiment was conducted with the objective of identifying optimum between plant space for optimum seed yielding and quality seed of cowpea for lowlands of Southern Ethiopia.

Materials and Methodology

Site description

Dilla substation is characterized by Orthic Luvisols soil, with an average annual rain fall and temperature of 1300 mm and 21^{0}C respectively. The average min and max temperature of the area are 13.10 and 28.05 ^{0}c respectively. It has an altitude of 1572 masl, and located at latitude and longitude of 38^{0}18'30'' E and 6^{0}24'30'' N respectively.

Treatments and data collection

The between plant space, 10cm, 20cm, 30cm and 40cm, were used as experimental treatments in a plot size of 3 x 2m with an inter-row spacing of 40 and 1m between replication and plots. Two seeds were sown together at the onset of main rainy season around mid of July with extra seedling thinned 14 days after germination, leaving one plant per station. A 100 kg/ha Di-ammonium phosphate (DAP) fertilizer was applied right before sowing. All plots were weeded two times before flowering. Number of branches per plant was counted by taking five plants per plot randomly. Number of pods per plant was also counted by using five plants per plot. Plants were harvested at ground level and fresh biomass weighed immediately using a 0.1 g scale. Then, a sub-sample of 15-20% of the total weight was separated and put into a paper bag for dry matter herbage determination. The samples were oven dried at 105 0C for 24 hours in Hawassa Agricultural research center soil Laboratory. To determine grain yield, the pods were harvested from the rest rows at optimum physiological maturity by hand picking and threshed.

Statistical analysis

The trial was laid out in a complete randomized block design with four replications and analyzed by analysis of variance using general linear model procedure of SPSS (version 20). Differences among means with P<0.05 were accepted as representing statistically significant differences. Tukey multiple comparisons was used to separate treatment means.

Result and discussion

Maximum yield of a particular crop in a given environment can be obtained at row spacing where competition among the plants is minimum. This can be achieved with optimum spacing which not only utilize soil moisture and nutrients more effectively but also avoids excessive competition among the plants. However, beyond certain limit yield cannot be increased with decreasing/increasing row spacing. Hence, optimum row spacing induces the plant to achieve its potential yield.

Number of branches

There was statistically significant difference in number of branches per plant between plant space of 30cm and 40 cm between rows which is in line with report conducted under irrigation by Armara *et.al,* 2017 they reported as there is increase in space there is increase number of branches per plant up to the optimum level at 40 X 20cm number of branches (18.42 plant-1). Our study indicated that there was no significant difference in number of branches per plant at 30 cm and 40 cm between plant spaces (table 2) this might be the indicative of optimum level of space for increase in number of branches per plant. Branches per plant higher in higher space between plants than lower space and positively correlated with seed yield. These results are in conformity with Angne et al. (1993), Yadav (2003) in cowpea.

Table 1. Effect of between plant space on number of branch per plant

Betweenn plant space	Mean	Std. Error	95% confidence interval	
			Lower Bound	**Upper Bound**
10 cm	12.0	.4	10.7	13.3
20 cm	14.8	.4	13.2	16.2
30 cm	18.5	.4	17.5	19.4
40 cm	20.0	.4	17.7	22.2

Number of pod per plant

There was statistically significant difference in number of pods per plant between plant space of 30cm and 40 cm between rows which is in line with report conducted under irrigation by Armara *et.al,* 2017 they reported as there is increase in space there is increase number of pods per plant up to the optimum level at 60 X 20cm number of pods (32-36 plant-1). Our study indicated that there was no significant difference in number of branches per plant at 30 cm and 40 cm between plant spaces (table

2) this might be the indicative of optimum level of space for increase in number of pods per plant. Pods per plant higher in higher space between plants than lower space and positively correlated with seed yield. These results are in conformity with Angne et al. (1993), Yadav (2003) in cowpea.

Table.2 Effect of plant space on pod/plant

Betweenn plant space	Mean	Std. Error	95% confidence interval	
			Lower Bound	Upper Bound
10 cm	18.50b	.774	15.814	20.186
20 cm	19.00b	.774	16.314	21.686
30 cm	24.25a	.774	22.564	25.936
40 cm	26.50a	.774	23.814	28.186

Dry matter yields

There was statistically significant difference in biomass yield of between plant space of 20cm and 40 cm between rows which is in contrary with report conducted under irrigation by Armara *et.al,* 2017 they reported as vegetative growth and number plant population increase there is increase there is increase with grain yield. The increase in grain yield and above ground biomass yield with 40 x 20cm row spacing was mainly due to significantly higher performance of all the growth and yield components compared 40 X 10 cm (table 3). These results are in conformity with Angne et al. (1993), Yadav (2003) in cowpea. As a result comparison in previous studies on cowpea which was conducted for herbage and seed yield on different genotypes, Ayana et al (2013) and Agza et.al (2012) reported dry matter herbage yield of different cowpea genotypes ranging between 2.78 t ha-1 and 7.67 t ha-1 and 2.33 t h^{-1} and 7.13 t h^{-1}, respectively. Ibrahim et al. (2006) obtained dry matter yields of over 4 t ha-1. The average herbage dry matter yields obtained in our study in the experimental period were in the range of those reported by (Ayana et al 2013; Ibrahim et al 2006) but quite lower than Rao and Shahid (2011) who found an average dry matter herbage yield of 18.1 t ha-1 for different cowpea genotypes.

Table 3. Effect of between plant space on Dry matter yield t/ha

Betweeen plant space	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
10 cm	4.28b	.06	4.1	4.5
20 cm	4.75a	.06	4.5	4.9
30 cm	4.45a	.06	4.2	4.6
40 cm	4.15b	.06	3.9	4.35

Grain yield

There was significant difference in seed yield at (p≤0.05) in 30 cm between plant space and 40 cm b/n row space than at 10 and 20 cm b/n plant space. The increase in grain yield with 40 x 30cm row spacing was mainly due to significantly higher performance of all the growth and yield components compared to 40 x 20cm and 40 X 10 cm (table 4). These results are in conformity with Armara *et.al,* 2017, Angne et al. (1993), Yadav (2003) in cowpea. Cowpea grain yield ranged 3.71 quintal to 11.4 quintal ha-1 in Ethiopia Ayana et al (2013), our result is in this range (7.05 quintal to 8.12 quintal ha-1). Other studies reported far lower result than current study; 2 quintal to 4 quintal ha^{-1} in Uganda (Omongo et al 1997), and 2 quintal to 3 quintal ha-1 in Nigeria (Alghali 1992). But the range of grain yield recorded at different between plant space in this study far lower than report of Agza et al (2012) and Goenaga et al (2011) who found that grain yield of different cowpea genotypes varied between 17.2 t h-1 to 34.7 t ha-1 and 15.56 quintal ha-1 to 36.82 quintal ha,-1 respectively even though there is variation in genotype, this might be variation in genotypes and other environmental factors.

Table 4. Effect between plant space on seed yield t/ha

Between plant space	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
10 cm	.705b	.021	.660	.750
20 cm	.758b	.021	.712	.783
30 cm	.812a	.021	.793	.858
40 cm	.805a	.021	.772	.833

Conclusion

There was significant difference in seed yield at (p≤0.05) in 30 cm between plant and 40 cm betweenn row space than at 10 and 20 cm between plant spaces. On the other hand relatively better DM yield was obtained in 20 cm between plants spaces than others between plant spaces. High biomass yield of crop residues was obtained minimum space between plant than higher between plant spaces. Pod per plant higher in higher space between plant than lower space and positively correlated with seed yield. So, in can be concluded for increased seed yield it is better to sow at 30 cm between plant spaces. On the other the other hand relatively better biomass yield of crop residues was obtained 20 cm space between plants.

Recommendation

It can be recommended that those who need for herbage production; better to use 40 cm between row space and 20 cm between plants space where as those who need forage seed as business source should use 40 cm between row space and 30 cm between plant**.** For further investigation adaptation trail of more potential cowpea genotypes at different environments is across years and under irrigation condition is recommended.

Acknowledgement

The authors acknowledge the South Agriculture Research Institute (SARI) and Jinka Agriculture Research centre for their financing the activity for its implementation

References

1. Agza B, Binyam K, Solomon Z, Eskinde A, Ferede A (2012). Animal feed potential and adaptability of some cowpea (vigna unguiculata) varieties in northwest lowlands of Ethiopia. Journal of Agricultural Research Vol. 1(11), pp. 478 – 483
2. Akinlade JA, Smith JW, Raji AM, Busari AA, Adekunle IO, Adewumi MK (2005). Effect of Two Cowpea (Vigna unguiculata) Fodder Cultivars as Supplements on Voluntary Intake, Milk Yield and Manure Production of Bunaji Cows. Journal of Agriculture and Rural Development in the Tropics and Subtropics. Volume 106, No. 2, 105– 112
3. Alemayehu M (1997). Conservation based forage development for Ethiopia. Self Help Development International and Institute for Sustainable Development. Berhanena Selam Printing Press, Addis Ababa, Ethiopia.
4. Angne, M.N., Patil, R.A., Mahadkar, U.V. And Khanvilkar, S.A., 1993, Response of cowpea to nitrogen, phosphorus and stand geometry. Journal of Maharashtra Agricultural Universities, 18(1): 121-122.
5. Armara Macimiliam Galwab and Prof. Peter Kamau, 2017. EFFECT OF SPACING ON GRAIN YIELD AND ABOVE GROUND BIOMASS OF COWPEA. International Journal of Climatic Studies, Vol.1, Issue No.1, pp. 24-35
6. Ayana E, Estefanos T, Ashenafi M, Abubeker H (2013). Advanced evaluation of cowpea (Vigna unguiculata) accessions for fodder production in the central rift valley of Ethiopia. Journal of Agricultural Extension and Rural Development Vol. 5(3), pp. 55-61
7. Ebro A, Nsahalai IV, Yami Umunna NN (2004). Effect of supplementing graded levels of forage legumes on performance of crossbred calves fed tef (Eragrostis tef) straw. J. Appl. Anim. Res. 26:107-102.
8. Goenaga R, Gillaspie AG, Quiles A (2011). Field performance of cowpea genotypes grown under virus pressure in puerto rico. African Crop Science Journal, Vol. 19, No. 2, pp. 97 – 103
9. Gwanzura T, Ng'ambi JW and Norris D (2012). Nutrient composition and tannin content of forage sorghum, cowpea, lablab and mucuna hays grown in Limpopo province of South Africa. Asian J. Anim. Sci. 5(12):1-7 071 E3 J. Agric.Res. Develop.
10. Hindrichsen I K, Osuji P O, Odenyo A A, Madsen J and Hvelplund T (2001), Effects of supplementation with four multipurpose trees and Labalab purpureus on rumen microbial population, rumen fermentation, digesta kinetics and microbial protein supply of sheep fed maize stover ad libitum. TSAP Proceedings Vol. 28. pp 98-119
11. Ibrahim MM, Rafiq A, Sultan M, Akram, Goheer MA (2006). Green fodder yield and quality evaluation of maize and cowpea sown alone and in combination. J. Agric. Res. 44:15–21.
12. Odion EC, Asiribo OE, Ogunlela VB, Singh BB, Tarawali SA (2007). Strategies to improve and sustain food production capacity in the savanna: The role of leguminous fodder crops in maintaining soil fertility and health. J. Food Agri. Environment. 5:338-344.
13. Rao NK, Shahid M (2011). Potential of cowpea [Vigna unguiculata (L.) Walp.] and guar [Cyamopsis tetragonoloba (L.) Taub.] as alternative forage legumes for the United Arab Emirates. Emir. J. Food Agric. 23 (2): 147-156
14. Seyoum B, Zinash S (1995). Chemical composition, in vitro digestibility and energy values of Ethiopian feed stuffs. In: Proceeding of the Third National Conference of the Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia
15. Turk KJ, Hall AE, Asbell CW (1980). Drought adaptation of cowpea. I. Influence of drought on seed yield. Agron. J. 72:413:420.
16. Yadav, G.L., 2003, Effect of sowing time, row spacing and seed rate on yield of cowpea under rain fed condition. Indian Journal of Pulses Research, 16 (2): 157-158. Crop Science 18: 29-34.
17. Yayneshet T, Eik LO, Moe SR (2009). The effects of enclosures in restoring degraded semi-arid vegetation in communal grazing lands in northern Ethiopia. Journal of Arid Environments, 73: 542-549.