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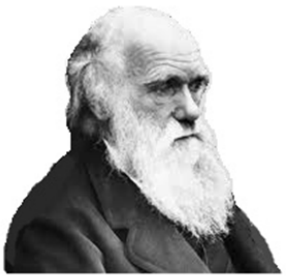

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Performance study of varieties and plant geometry on productivity of cowpea (*Vigna unguiculata* (L.) Walp) at Bharatpur, Chitwan, Nepal

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ABSTRACT

The study about performance of different varieties and plant geometry on productivity of cowpea (*Vigna unguiculata* L.) was carried at Bharatpur, Chitwan from duration of February to May. The effect of two variety (Prakash and Surya) and four spacing (60 cm × 10 cm, 60 cm × 15 cm, 60 cm × 20 cm and 60 cm × 25 cm) were studied using two factor Randomized Complete Block Design (RCBD) having eight treatment replicated three times consisting of 24 plots. The main objective of the research is to find out the best variety and appropriate spacing for getting higher yield of cowpea. Results revealed that variety Surya showed the highest grain yield (1.25 t/ha) followed by Prakash (1.06 t/ha). Whereas, in case of spacing, the highest grain yield was obtained in 60 cm × 15 cm (1.33 t/ha).Similarly in combine treatment; the highest grain yield (1.47 t/ha) was obtained in combination of Surya and 60 cm × 15 cm. From experiment it is concluded, the combination of Surya and 60 cm × 15 cm gives highest productivity compared to all other treatments at terai region of Nepal.

Keywords: Biological yield, Grain yield, Harvest index, Profitability, Productivity

1. INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) a commercial crop having both vegetative and agronomic importance belongs to the family Fabaceae, sub- family Faboideae with genus Vigna. It is one of the oldest crops to be farmed which was domesticated from Africa. Cowpea

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is a grain legume with large economic and social importance especially grown in tropical and sub-tropical region of less developed countries (Singh *et al*., 1997; Timko *et al*., 2008). It is the major source of protein, carbohydrate dietary, antioxidants and polyunsaturated nutritional and nutraceuticals (Da Silva *et al*., 2108), whereas leaves contain 27 to 30 % protein (Ahenkora *et al.*,1998) which is used as fodder and husks for livestock. Cowpea is grown in various area for the purpose of restoring soil fertility as well as used as rotating, inter-crop due to presence of nodules which helps for nitrogen fixation about 40 to 80 kg N ha^{-1} in the soil (Meena *et al.*, 2015). It is a used for the food security and good health of large populations on many continents (Silva *et al* ., 2018).

Worldwide, cowpea cultivation covers about 14.5 million ha of land, which produces 6.5 million MT of cowpea dry grains (Boukar *et al.*, 2016). Similarly in the context of Nepal, it is cultivated in an area of 23,492 ha with the production and productivity of 19,928 Mt and 848 kg/ha respectively (MoALD, 2019). It is mainly grown for the purposes vegetables, dhal and green manure at Terai to mid hills region of Nepal (Dhakal, 2020).

Different cultivars required different climatic conditions as well as different spacing. If the spacing is maintained properly, the productivity as well as supply duration of cowpea can be increased. Proper spacing helps to utilize fertilizer, soil moisture and helps to evades enormous competition between weeds and plant (Naim *et al.*, 2010). Also, the optimum maintenance of plant density at certain area is significant apparatus for enhancement of crop growth and helps to accomplish maximum grain yield and biomass of the crop (Liu *et al.*, 2008). Hence it is very necessary to conduct site based researches and site specific recommendations regarding the appropriate spacing for cowpea in Nepal. Therefore, this study was aimed to assess the effect of plant spacing and varieties on yield characters of cowpea and to find out the best interaction between varieties and plant spacing for better yield.

2. METHODOLOGY

The field experiment was conducted at Bharatpur, Chitwan during spring season 2022. Geographically, it is located at 27°70’ North latitude and 84°05’ East longitude with elevation of 208 m above the see level. Analysis of soil was done by taking soil sample of experimental field from 15-20 cm depth before the field preparation. The soil was found sandy-clayed in texture, low in available nitrogen (0.61%), low in available phosphorus (17.41 kg ha^{-1}), low in available potassium was (70.08 kg ha^{-1}), medium organic carbon (4.72%) and acidic in soil reaction (5.65 pH). Field experiment was laid out in two-factor Randomized Complete Block Design (RCBD) with twenty-four plots having each plot size of 3 m × 2 m (6 m^2) consisting of eight treatments and three replications. The treatments consist of two different factors; variety and spacing. Factor A was Variety: (i) V_1: Prakash and (ii) V_2: Surya and Factor B was Spacing (i) S_1: 60 cm × 10cm (ii) S_2: 60 cm × 15cm (iii) S_3: 60 cm × 20 cm and (iv) S_4: 60 cm × 25 cm.

The experimental field was pulverized, leveled and well drained. Seed sowing was done 3-4 cm below the soil after the preparation of field according to different spacing treatments by dibbling method at second week of February. Dibbling method was castoff to maintain uniformity at each row and column. Seed required per plot was calculated, weighted separately and sown according to spacing where 60 cm × 10 cm spacing required 166666 seed ha^{-1}, 60 cm × 15 cm required 111111 seed ha^{-1}, 60 cm × 20 cm required 83333 seed ha^{-1}, 60 cm × 25 cm required 66666 seed ha^{-1}.

To maintain uniformity among plant population gap feeling was done at 10th day of sowing. The recommended dose of fertilizer; 20:40:20 kg NPK/ha was applied where full recommended dose of potassium (K_2O) and phosphorus (P_2O_5) and half dose of nitrogen (urea) were applied at the time of final field preparation. The remaining half dose of nitrogen was applied at split dose after 20 days of sowing. Irrigation was given at the interval of two days. Significant numbers of weed was also found in the experimental plots so hand weeding was done at 30 days and 20 days after first weeding.

The plants from the net plot were harvested and left for sun dry in the field. Then before threshing, weight of total dry biomass from net plot was recorded and weight of dry leaves from net plot were also added at biological yield. The collected pods were threshed to remove grain/seed from the pods. Then from every single plot, the grains were weighted and grain weight is recorded in ton hac^{-1}. For statistical analysis data recorded was systematically arranged in MS-Excel, which was used for simple statistical analysis, contributing graphs and tables. The compiled data were subjected to Analysis of Variance (ANOVA) using R- Studio.

3. RESULTS AND DISCUSSION

3. 1. Growth parameter

The mean plant height, leaf area index (LAI), number of leaves and pod length as influenced by variety and spacing is shown in Table 1. Effect of variety as well as spacing on plant height, LAI and number of leaves as observed were statistically significantly influenced. The highest plant height per plant (96.83), leaf area index (0.22), number of leaves (37), pod length (17.75) was found superior in variety Surya compared to variety Prakash. Similarly in spacing; the maximum plant height at 60 cm × 15 cm (90.20), LAI at spacing 60 cm × 10 cm (0.36), number of leaves (38) and pod length (17.89) was found at spacing of 60 cm × 20 cm. Similar observation was reported in a study by (Naim *et al.*, 2010) where they observed that increased plant densities led to increase in plant height.(Alessi *et al*., 1977; MacGowan *et al*., 1991; Xinyou *et al*., 2003) reported that plantation of crop at high densities will consequently increase leaf area index due to improve in efficiency of light interception; which agree with the finding of our experiment.

Table 1. Growth parameters of cowpea as influenced by variety and spacing at Bharatpur, Chitwan, 2022.

Treatment	Plant height (cm)	Leaf area index	No. of green leaves/plant	Pod length(cm)
Factor A:Variety				
V_1:Prakash	57.09^b	0.18^b	28^b	17.49
V_2:Surya	96.83^a	0.22^a	37^a	17.75
SEM (±)	0.27	0.01	0.21	0.14
LSD value	1.66	0.02	1.30	0.86

CV%	1.2	5	2.2	2.8
F test (0.05)	***	*	**	NS
Factor B: Spacing				
S_1:60 cm × 10 cm	83.08[b]	0.36[a]	28[d]	17.07
S_2:60 cm × 15 cm	90.20[a]	0.20[b]	35[b]	17.80
S_3:60 cm × 20 cm	66.11[d]	0.14[c]	38[a]	17.89
S_4:60 cm × 25 cm	68.46[c]	0.11[d]	31[c]	17.72
SEM (±)	0.54	0.01	0.40	0.32
LSD value	1.68	0.01	1.24	0.98
CV%	1.8	5.9	3	4.5
F test (0.05%)	***	***	***	NS
Grand mean	76.96	0.21	33	17.62

Note: Mean followed by the same letter(s) in a column do not differ at 5 % level of significance by DMRT, CV = Coefficient of variance, SEM = Standard error of mean, LSD = Least significant difference.

3. 2. Yield attributes and yield parameters

The yield and yield attributing parameters like, test weight, grain yield, biomass, harvest index as influenced by variety and spacing shown in Table 2. All yield parameters was significantly affected by variety, spacing and combination of variety and spacing except the number of grains per pod which was not significantly affected by variety but was significant at spacing. The highest no. of grains per pod (14) and test weight (33.41gm) was found in variety Surya which was statistically similar with no. of grains per pod of variety Prakash (13). Similarly, the highest test weight (33.41), grain yield (1.25), biomass (5.66), harvest index (30.74) were recorded in variety Surya. Nwofia *et al*., (2013) reported that the variation among varieties and its productivity could be due to the growth habit and the genetic potential of each genotype.

Table 2. Yield attributing and yield parameters of cowpea as influenced by variety and spacing at Bharatpur, Chitwan, 2022.

Treatment	No. of grains/pod	Test weight (g)	Grain yield (ton/ha)	Bio-mass (ton/ha)	Harvest index (%)
Factor A :Variety					
V_1: Prakash	13	33.08[a]	1.06[b]	3.61[b]	23.47[b]

V_2: Surya	14	33.41[a]	1.25[a]	5.66[a]	30.74[a]
LSD value	1.19	4.18	0.097	0.85	3.42
CV%	5.2	1.8	4.8	10.5	7.2
F test (0.05)	NS	**	*	**	*
Factor B :Spacing					
S_1: 60 cm × 10 cm	14[a]	130.53[b]	0.92[c]	5.08[a]	19.30[c]
S_2: 60 cm × 15 cm	13[b]	134.12[a]	1.33[a]	4.71[a]	33.16[a]
S_3: 60 cm × 20 cm	13[b]	127.60[c]	1.31[a]	3.93[b]	33.36[a]
S_4: 60 cm × 25 cm	13[ab]	131.39[b]	1.06[b]	4.82[a]	22.60[b]
LSD value	0.62	1.60	0.064	0.62	2.92
CV%	3.8	1	4.5	10.7	8.6
F test (0.05)	*	***	***	**	***
Grand mean	13.16	130.98	1.15	4.63	27.11

Note: Mean followed by the same letter(s) in a column do not differ at 5 % level of significance by DMRT, CV = Coefficient of variance, SEM = Standard error of mean, LSD = Least significant difference.

In in case of different spacing; the highest no. of grains per pod (14), biomass (5.08) at plant geometry 60 cm × 10 cm; test weight (134.12), grain yield (1.33) in plant geometry of 60 cm × 15 cm and maximum harvest index (33.36) at plant geometry 60 cm × 20 cm respectively. Similar experiment was done by (Boateng *et al.,* 2019) where it explained that maximum 1000 seed test weight was obtained by spacing of 45 cm × 15 cm. (Jakusko *et al.,* 2013) also experimented the experiment in sesame plants which identify that the increase in spacing significantly increased the number of pods per plant. Similar results were obtained by (Boateng *et al.,* 2019) where it was reported that maximum biomass yield was obtained by spacing of 60 cm × 15 cm.

Similar experiment by (Naim *et al.,* 2010) reported, increasing plant population decreased grain yield per plant. Cowpea cultivars had a highly significant effect on harvest index since they differ in the partitioning of assimilates to the grain was reported by Jakusko *et al.,* (2013). Cowpea in double rows on ridges spaced 75 cm apart having plant population of 266666 plants ha^{-1} permit best grain and fodder yield (Tofa *et al.,* 2018).

3. 3. Interaction Effects

At interaction effect of cowpea varieties and different spacing shows that the combination of Surya with spacing 60 cm × 10 cm gives highest no. of grains per pod (15) whereas the maximum test weight (140.56 gm), grain yield (1.47 ton ha^{-1}), biomass (6.69 ton ha^{-1}), harvest index (44.19) were found in Surya combining with spacing 60 cm × 15 cm.

The similar experiment was conducted by (Nderi *et al.*, 2020) where cowpea variety KVU 27-1 with spacing of 40 cm × 20 cm gives maximum cowpea grain yield at Kilifi County.

Table 3. Interaction effect of varieties and different spacing on yield attributes and yields of cowpea at Bharatpur, Chitwan, 2022

Treatment	No. of grains/pod	Test weight (g)	Grain yield (ton/ha)	Bio-mass (ton/ha)	Harvest index (%)
Interaction effect					
V_1.Prakash × S_1 (60 cm × 10 cm)	13^{bc}	123.33^{ef}	0.84^{e}	3.74^{c}	22.78^{de}
V_1.Prakash × S_2 (60 cm × 15 cm)	13^{bc}	127.68^{d}	1.20^{b}	2.72^{d}	22.13^{de}
V_1.Prakash × S_3 (60 cm × 20 cm)	12^{c}	122.67^{f}	1.17^{bc}	3.83^{c}	30.54^{c}
V_1.Prakash × S_4 (60 cm × 25 cm)	13^{bc}	125.53^{de}	1.04^{d}	4.15^{c}	25.46^{d}
V_2.Surya × S_1 (60 cm × 10 cm)	15^{a}	137.73^{b}	1.01^{d}	6.42^{a}	15.83^{f}
V_2.Surya × S_2 (60 cm × 15 cm)	13^{bc}	140.56^{a}	1.47^{a}	6.69^{a}	44.19^{a}
V_2.Surya × S_3 (60 cm × 20 cm)	13^{b}	132.54^{c}	1.45^{a}	4.03^{c}	36.19^{b}
V_2.Surya × S_4 (60 cm × 25 cm)	13^{b}	137.25^{b}	1.45^{a}	5.49^{b}	19.73^{ef}
LSD value	0.88	2.27	0.09	0.88	4.13
CV%	3.8	1	4.5	10.7	8.6
F test (0.05)	**	.	**	***	***
Grand mean	13.16	130.98	1.15	4.63	27.11

Note: Mean followed by the same letter(s) in a column do not differ at 5 % level of significance by DMRT, CV = Coefficient of variance, SEM = Standard error of mean, LSD = Least significant difference.

4. CONCLUSION

Almost in every vegetative and agronomic aspect variety Surya and plant geometry of 60 cm × 15 cm containing 111111 plants ha^{-1}provide better outcome compared to variety Prakash and other plant geometry. Similarly in interaction case also, combination of Surya with spacing of 60 cm × 15 cm (having 111111plant ha^{-1}) gives maximum productivity of cowpea. From the experiment it is determined that neither higher nor lesser plant density gives maximum productivity but felicitous number of plants depending upon canopy coverage area of variety and its characteristics is required higher productivity.

References

[1] Ahenkora, K., Adu Dapaah, H. K., & Agyemang, A. (1998). Selected nutritional components and sensory attributes of cowpea (Vigna unguiculata [L.] Walp) leaves. *Plant Foods for Human Nutrition*, 52(3). https://doi.org/10.1023/A:1008019113245

[2] Alessi, J., Power, J. F., & Zimmerman, D. C. (1977). Sunflower yield and water use as influenced by planting date, population, and row spacing 1. *Agronomy Journal*, 69(3), 465-469

[3] Boakye Boateng, A., & Wilson, G. (2019). Effect of cowpea (Vigna unguiculata) variety and plant spacing on grain and fodder yield. *Asian J. Adv. Agric. Res*, 10(1), 1-9

[4] Boukar, O., Fatokun, C. A., Huynh, B. L., Roberts, P. A., & Close, T. J. (2016). Genomic tools in cowpea breeding programs: Status and perspectives. *Frontiers in Plant Science* Vol. 7, Issue . https://doi.org/10.3389/fpls.2016.00757

[5] da Silva, A. C., da Costa Santos, D., Junior, D. L. T., da Silva, P. B., dos Santos, R. C., & Siviero, A. (2018). Cowpea: A strategic legume species for food security and health. *Legume Seed Nutraceutical Research*. DOI:10.5772/intechopen.79006

[6] Dhakal, A. (2020). Present status of grain legumes production in Nepal. *Food & Agribusiness Management*, 2(1), pp. 06–09. doi:10.26480/fabm.01.2021.06.09

[7] El Naim, A. M., & Jabereldar, A. A. (2010). Effect of plant density and cultivar on growth and yield of cowpea (Vigna unguiculata L. Walp). *Australian Journal of Basic and Applied Sciences* 4(8): 3148-3153

[8] Jakusko, B. B., Usman, B. D., & Mustapha, A. B. (2013). Effect of row spacing on growth and yield of sesame (Sesamum indicum L.) in Yola, Adamawa State, Nigeria. *Journal of Agriculture and Veterinary Science*, 2(3), 36-39

[9] Liu, X., Jin, J., Wang, G., & Herbert, S. J. (2008). Soybean yield physiology and development of high-yielding practices in Northeast China. *Field Crops Research*, 105(3), 157-171

[10] McGowan, M., Taylor, H. M., & Willingham, J. (1991). Influence of row spacing on growth, light and water use by sorghum. *The Journal of Agricultural Science*, 116(3), 329-339

[11] Meena, H. K., Ram Krishna, K., and Singh, B. 2015. Character associations between seed yield and its components traits in cowpea [Vigna unguiculata (L.) Walp.]. *Indian Journal of Agricultural Research*, 49(6). https://doi.org/10.18805/ijare.v49i6.6688

[12] MoALD. (2018/19). Krishi Diary 2075. Agriculture Information and Communication Centre, Hariharbhawan, Lalitpur, Nepal. 117p.

[13] Nderi, L. M. (2020). Effect of different spacing intervals on growth and yield of cowpea varieties in Kilifi County, Kenya (Doctoral dissertation, KeMU).

[14] Nwosu, D. J., Olatunbosun, B. D., & Adetiloye, I. S. (2013). Genetic variability, heritability and genetic advance in cowpea genotypes in two agro-ecological environments. *Greener Journal of Biological Sciences*, 3(5), 202-207

[15] Singh, B., Chambliss, O. & Sharma, B. (1997). Recent advances in cowpea breeding. In B.B. Singh, D.R. Mohan Raji and K.E. Dashiel, Advances in cowpea research. Ibadan, Nigeria: IITA, (p. 30-49).

[16] Timko, M.P., Singh, B. (2008). Cowpea, a Multifunctional Legume. In: Moore, P.H., Ming, R. (eds) Genomics of Tropical Crop Plants. Plant Genetics and Genomics: Crops and Models, vol 1. Springer, New York, NY. https://doi.org/10.1007/978-0-387-71219-2_10

[17] Tofa, A. I., Kyei-Boahen, S. T. E. P. H. E. N., Solomon, R., Ajeigbe, H. A., & Kamai, N. (2018). Effects of plant density on the performance of cowpea in Nigerian savannas. *Experimental Agriculture*, 54(1), 120-132

[18] Yin X, Lantinga EA, Schapendonk AH, Zhong X. Some quantitative relationships between leaf area index and canopy nitrogen content and distribution. *Ann Bot.* 2003 Jun; 91(7): 893-903. doi: 10.1093/aob/mcg096