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Effect of Varieties and Plant geometry on yield attributes and yield of grain cowpea (*Vigna unguiculata*)

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Abstract
A field experiment was conducted at Department of Agronomy, Faculty of Agriculture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, U.P. during *kharif* 2024 on loamy sand soil. The field experiments to evaluate the growth and yield of three cowpea varieties (Kashi Kanchan, Sadabahar and Gomti) were sown in three plants spacing (30cm ×15cm, 40cm×10cm and 50cm×10cm). A randomised complete block design with three replications were used for the field experiments. The cowpea variety were Sadabahar and Plant Spacing of 40 cm × 10 cm containing provides better performance for growth and yield attributes, compared to variety Kashi Kanchan, Gomti and other Plant geometry. 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 are required for higher productivity.

Keywords: Cowpea, Plant Geometry, Growth, Economics

Introduction
Cowpea (*Vigna unguiculata* L. Walp) is a centuries-old human crop, having originated in Africa and spread throughout Latin America and Southeast Asia. It's a warm-season, vascular annual pulse crop with a wide range of uses. It is a member of the Fabaceae family. The black-eyed pea, black-eyed bean, Crowder pea, Southern pea, are all names for this legume crop. Africans have been domesticating and farming cowpeas for decades to get protein for themselves and their livestock feed. It's currently grown throughout the world, with a particular emphasis on the tropics. The cowpea grows best in plains foliage, with temperatures ranging from 25 to 35° Celsius and annual rainfall ranging from 750 to 1100 mm. It is more resistant to sandy soils and drought than soyabeans. It may grow in a variety of soil types, as long as they are well-drained. Its output has increased 2.7 times since 2000, reaching 8.9 million metric tons in 2019 (Belete).
Cowpea (*Vigna unguiculata* L. Walp), often known as southern pea or black eye pea, is a major grain legume in tropics. It is an important component of traditional cropping systems in the semi-arid tropical regions. Cowpeas are among the oldest pulse crops in the Asian and African tropics. Vegetable meat is noted for its high protein content and vitamin density. In India, it is planted mostly in Uttar Pradesh, Madhya Pradesh, Bihar, Punjab, Haryana, Rajasthan, and Himachal Pradesh, where it is grown for both vegetable and pulse purposes and is a highly profitable crop. Cowpea is predominantly grown in semi-arid lowland tropics and subtropics with poor soils and insufficient rainfall (Singh *et al*.1997) [8].
Cowpea whole grains have comparable dietary components to other legumes, with a little fat content and enormous protein value. It contains 23-32% protein, 50-60% carbohydrates, and 1% fat. It has 2 to 4 times more protein than cereal and root crops, and it is high in lysine. It has a reasonable amount of dietary fibre, phytochemicals, minerals, and vitamins.
(FAOSTAT database).
Cowpea are among the most significant legume crops. It has gained popularity in recent years due to its high food value, outstanding fodder, and potential as an excellent green

manure crop. Cowpea is a drought-tolerant crop that grows better in warmer climates. It may grow in soil with low (pH range 4.5-9), low organic matter, high sand content ((>85%), and little rainfall. All of the cowpea plant's edible components are high in protein, vitamins, and minerals. Its grain comprises around 23-25% protein, and 50-70% carbohydrate (Vir and Singh 2014) [9]. Aside from this, cowpea generates great feed, has a robust vegetative growth, and covers the ground so effectively that it checks soil erosion.

Spacing is one of the most important agricultural practices that affects the growth and yield of broad been and it is well known that the number of plants/unit area is one of the most important factors determining productivity (Abd-Elaziz *et al*., 2019) [1]. Plant spacing is an essential factor that influences crop production and yield components. Researchers looked into how legume plants react to varied plant densities. Plant densities is one of the most significant and effective elements in the fixation of agricultural production, although it varies by variety and environment (Dahmardeh *et al.*2010) [3].

Materials and Methods

This experiment was carried out during *Kharif* 2024 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28 ºN latitude,81.54 ºE longitude and 98m altitude above the mean sea level. This area situated on the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Prayagraj, city. The climate of this region is typically sub-tropical and semi-arid with monsoon commencing by the third week of June and with drawing by end of September. The temperature reached up to 48 ºC and in winter it goes down to as low as 2-3 ºC. During the summer hot scorching winds known as *"Loo"* and frost during winter months are common features. Experimental mechanical analysis of the soil was sand 59.50(%), silt 24.10(%). Clay 16.40 (%) and textural class silt loam, while chemical analysis of soil was available nitrogen (242 kg/ha), available potassium (95 kg/ha), organic carbon (0.40%), pH (7.50) and EC (0.19ds/m). The experiment was laid out in a randomized block design with three replications. Treatments consisted of three levels of plant spacing 30cm×15cm, 40cm×10cm and 50cm×10cm respectively. Three varieties of cowpea: Kashi Kanchan, Sadabahar and Gomti were used and respectively. The recommended dose of fertilizers 20:40:20 N-P-K was applied according to the treatment details as through Urea, SSP, MOP. Whole of nitrogen, phosphorous, potash was applied as basal at the time of Sowing, Thinning & Gap filling was done at 20 DAS to maintain the plant population according to treatment in order to attain recommended plant population for proper growth and yield of crop. To control the infestation of red hairy caterpillar application of dimethoate which reduces pest population. Weeding was done to remove all weeds from the field in order to check any form of initial crop-weed competition and also checks the spread of diseases. Hand weeding was done 25 DAS & 45 DAS. Five representative healthy plants were selected and tagged randomly to take observations. The yield attributing characteristics such as Number of pods per plant, Number of seeds per pod, Test Weight, Seed Yield, Stover Yield, Harvest Index were calculated.

Results and Discussion

The post-harvest performance of cowpea varieties and planting spacing was examined in Table 1. The number of pods per plant at harvest was significantly influenced by the variety and planting spacing. The maximum number of pods per plant was recorded in T_5 (Sadabahar + Spacing 40 cm × 10 cm), followed by T_6 (Sadabahar + Spacing 50 cm × 10 cm) and T_1 (Kashi Kanchan + Spacing 30 cm × 15 cm). These results are in line with Ndor *et al.* (2012), Jakusko, Chaudhry *et al.* (2014). The combinations of varieties and plant spacing T_6 and T_7 were found to be statistically significant at par T_5 (Sadabahar + Spacing 40 cm × 10cm). Similarly, the maximum and most significant number of seeds/pod was recorded in T_5 (Sadabahar + Spacing 40 cm × 10cm), followed by T_7 (Gomati + Spacing 30 cm × 15 cm) and minimum in T_1 (Kashi Kanchan + Spacing 30 cm × 15 cm). The maximum and most significant number of test weight (g) was recorded in T_5 (Sadabahar + Spacing 40 cm × 10cm), followed by T_7 (Gomati + Spacing 30 cm × 15 cm) and minimum in T_1. The maximum and most significant number of seed yield (t/ha) was recorded in T_5 (Sadabahar + Spacing 40 cm × 10cm), followed by T_6 (Sadabahar + Spacing 50 cm × 10 cm) and minimum in T_2. Similarly finding by Tanya *et al*., (2015) and Jag dale *et al*., 2017. The combinations of varieties and plant spacing T_3, T_4, T_6 and T_7 were found to be statistically significant at par T_5 (Sadabahar + Spacing 40 cm × 10cm). Although the maximum and most significant number of harvest index (%) was recorded in T_9 (Gomti + Antar 50 cm × 10 cm) followed by T_8 (Gomti + Antar 40 cm × 10 cm) and lowest in T_4. These results are in line with Narayanankutty in cowpea and Sawardekar (2007) in yard long bean. This may be due to higher seed yield of introduced cultivars. Similar results were reported by Suliman (2000) who found that the introduced cultivars had greater harvest index than the local cultivar. Also, these results are in line with Nigude *et al*. (2004), Narayanankutty in cowpea and Sawardekar (2007) in yard long bean.

The data recorded there is significant difference among all the treatments. However, highest test weight (134.4 g) was observed in treatment 5 [Sadabahar + (30cm×15cm)].

Conclusion

It was concluded that for obtaining higher yield components with better quality of cowpea application of Sadabahar + Spacing 40 cm × 10 cm was recorded significantly higher number of pods/plant (23.66), Seeds/pod (15), Test Weight (134.4) and Seed Yield (1.423 kg/ha) as compared to other treatments. Since, the finding based on the research done in one season, further trails are required to confirm the results and make specific recommendations on varieties and crop geometry for cowpea under different geographical conditions.

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Table 1: Evaluation of different varieties of cowpea and spacing (*Vigna unguiculata* L.) on post-harvest observations.

Treatments		Number of Pods/plat	Number of Seeds/pod	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
T_1	Kashi Kanchan + Spacing 30 cm × 15 cm	14.33	10.00	108.5	0.780	1.759	30.72
T_2	Kashi Kanchan + Spacing 40 cm × 10 cm	17.66	12.00	109.1	0.873	1.453	37.53
T_3	Kashi Kanchan + Spacing 50 cm × 10 cm	15.00	10.33	107.1	0.818	3.377	19.50
T_4	Sadabahar + Spacing 30 cm × 15 cm	15.33	10.00	112.1	0.756	3.379	18.28
T_5	Sadabahar + Spacing 40 cm × 10 cm	23.66	15.00	134.4	1.423	3.536	28.70
T_6	Sadabahar + Spacing 50 cm × 10 cm	23.33	13.33	120.6	1.358	3.471	28.12
T_7	Gomati + Spacing 30 cm × 15 cm	23.38	14.33	134.3	1.411	3.475	28.88
T_8	Gomati + Spacing 40 cm × 10 cm	17.33	12.00	116.0	0.813	1.427	36.29
T_9	Gomati + Spacing 50 cm × 10 cm	14.66	11.67	118.5	0.821	1.334	38.10
	F- test	S	S	S	S	S	S
	S. Em. (±)	0.882	1.220	0.668	0.882	0.966	1.125
	C. D. (p = 0.05)	1.820	2.517	1.380	1.820	1.993	2.323

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