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Effect of varieties and plant geometry on growth 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 (30 cm ×15cm, 40 cm×10 cm and 50 cm×10 cm). 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), 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 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 °C and in winter it goes down to as low as 2-3 °C. 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 30 cm×15cm, 40 cm×10 cm and 50 cm×10 cm 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 growth contributing characteristics such as Plant height(cm), Plant dry weight (g), Number of Nodules/Plant (No.), CGR and RGR were calculated and Economics were also calculated.

Results and Discussion

Table 1 and 2 present the results of the growth and economics performance of various cowpea varieties and spacing. The maximum plant height was recorded in T5 (Sadabahar +Spacing 40 cm × 10 cm) at harvest, followed by T6 (Sadabahar + Spacing 50 cm × 10 cm). The combinations of varieties and plant spacing T2,T3,T6,T7 and T9 were found to be statistically equivalent to T5 (Sadabahar + Spacing 40 cm × 10 cm).Similarly, the mean maximum number of nodules per plant was recorded in T5 (Sadabahar + Spacing 40 cm × 10 cm) (11.33), followed by T6 (10.89) and minimum(8.11) in T1.The combinations of varieties and plant spacing treatments T7 (Gomti + Spacing 30 cm × 15 cm) were also statistically equivalent to T5(Sadabahar +Spacing 40 cm × 10 cm) (25.13), followed by T7 (24.46) and minimum (16.69) in T1. The combinations of varieties and plant spacing treatment T6 and T7 were found to be statistically equivalent to T5 (Sadabahar + Spacing 40 cm × 10 cm). However, the maximum crop growth rate was recorded in T9 (Gomti + Spacing 50 cm × 10 cm) (6.15), followed by T4 (Sadabahar + Spacing 40 cm × 10 cm) (6.10) and minimum (3.55) in T1. The maximum relative growth rate was recorded in T5 (Sadabahar + Spacing 40 cm × 10 cm) (204), followed by T7 (Gomti + Spacing 50 cm × 10 cm) (0.202) and minimum (0.178) in T1. Similar results were reported by this may be happened due to higher plant population in narrow spacing and there was more vegetation and dry matter accumulation was higher resulted in more yields of seed per plant. These results are in conformity with the results of Santiesteban *et al.* (2002) [7]. Also, similar result found by Naim and Jabereldar (2010) [6] reported that, plant density had a significant effect on most of the growth attributes measured. The cultivar (Sadabahar) had significantly taller plants in two seasons compared to others. Differences among cultivars in plant height were reported by Miller (1988) [4] and Mohammed (2002) [5].

The cost of cultivation, total income, net profit and return per rupee invested have been worked out and presented in Table 2. The differences had significant effect on growth of cowpea due to different levels of spacing was responsible for significant variation in their own growth and yield. Within T5((Sadabahar + Spacing 40 cm × 10 cm) recorded maximum gross return as well as net return and B:C ratio. Returns per rupee invested i.e. B:C was also the highest with T_5 (Sadabahar + Spacing 40 cm × 10 cm) Minimum gross return, net return and B: C ratio was observed in T_1 (Kashi Kanchan + Spacing 30 cm × 15 cm). This may be due to higher economic yield produced by the wider range of spacing and higher plant population/hectare. These results are in conformity with the results of Chhangani (2003) [2].

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

Treatments Combinations		Plant height (cm)	No of nodules/ plant	Dry weight (gm)	CGR (g/m^2/ day)	RGR (g/g/day)
T_1	Kashi Kanchan + Spacing 30 cm × 15 cm	66.42	8.11	16.69	3.55	0.178
T_2	Kashi Kanchan + Spacing 40 cm × 10 cm	70.08	8.33	20.91	4.35	0.192
T_3	Kashi Kanchan + Spacing 50 cm × 10 cm	71.55	9.33	19.24	5.26	0.186
T_4	Sadabahar + Spacing 30 cm × 15cm	69.28	10.22	22.80	6.10	0.197
T_5	Sadabahar + Spacing 40 cm × 10 cm	75.35	11.33	25.13	5.91	0.204
T_6	Sadabahar + Spacing 50 cm × 10 cm	66.28	10.89	23.91	5.63	0.200
T_7	Gomti + Spacing 30 cm × 15 cm	63.28	10.00	24.46	5.43	0.202
T_8	Gomti + Spacing 40 cm × 10 cm	62.02	9.00	22.14	6.00	0.195
T_9	Gomti + Spacing 50 cm × 10 cm	61.08	9.67	19.53	6.15	0.187
	F- test	S	S	S	S	S
	S. Em. (±)	1.500	0.516	0.762	1.751	0.003
	C. D. (p = 0.05)	3.096	1.064	1.574	3.615	0.005

Table 2: Effect of different crop varieties on Economics of cowpea (*Vigna unguiculata* L.)

Treatment	Cost of cultivation	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
T1	39248.1	99163.96	59915.8	1.53
T2	39588.7	106132.58	66543.88	1.68
T3	39571.2	103938.325	64367.08	1.63
T4	39748.1	99494.52	59746.36	1.50
T5	40088.7	149723.58	109634.88	2.73
T6	40071.2	144794.725	104723.48	2.61
T7	38483.1	147162.32	108679.16	2.82
T8	38823.7	100867.98	62044.28	1.60
T9	38806.2	101354.005	62547.76	1.61

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