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Growth Parameters of Pigeonpea and Greengram as Influenced by Different Cropping Geometry and Intercropping Ratio

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Abstract

The enhancement of higher yield in pigeonpea productivity due to increasing demand in Indian situation should be supported by the maintenance of optimum plant population under irrigated situation paving a way through intercrop for utilizing the resources effectively. This experiment was conducted to study about the effect of different planting geometry and intercrop on pigeonpea. The study was laid out in randomized block design with twelve treatment combinations in three replications. The results of the study revealed that higher plant height, total branches, stem girth was higher in planting geometry (120 x 30 cm) of pigeonpea with greengram in 1:3 row ratio over other treatments. In greengram, the growth parameters were higher in wider planting geometry (180 x 60 cm) of pigeonpea under 1:5 row proportion.

Introduction

Pulses are the basic ingredient in Indian diets and excellent feed and fodder for livestock. Endowed with the unique ability of biological nitrogen fixation, carbon sequestration, soil amelioration, low water requirement and capacity to withstand harsh climate, pulses have remained an integral component of sustainable crop production system since time immemorial, especially in the dry areas. They also offer good scope for the crop diversification and intensification. Though pulses are protein rich crops but they are still being cultivated in more than 78 per cent of the energy starved rainfed condition.

Among pulses, pigeonpea (*Cajanus cajan* L.) is one of the major grain legume crop of tropical and subtropical regions and it is grown predominantly under rainfed conditions. Pigeonpea as soil ameliorant is known to provide several benefits to soil in which it is grown. When pigeonpea is grown as a sole crop, it is relatively inefficient because of its slow initial growth rate and low harvest index (Willey *et al*, 1980); therefore it is grown as intercrop, which helps in efficient utilization of available resources for enhancing the productivity and profit. Pigeonpea is suitable for inter-cropping with different crops like cotton, sorghum, pearlmillet, greengram, blackgram, maize, soybean and groundnut for increasing production and maintaining soil fertility. The initial slow growth rate and deep root system of pigeonpea offers a good scope for intercropping with fast growing early maturing and shallow rooted crops (Ramamoorthy *et al*., 2004).

Greengram (*Vigna radiata* L.) also one of the most important pulse crop in India because of its adaptation to short growth duration, low water requirement, low soil fertility. Being a leguminous crop, it has the capacity to fix atmospheric nitrogen through symbiotic nitrogen fixation and also used as a green manure crop. It also provides an excellent green fodder to the animals. As short duration crop, it fits well in various multiple and intercropping systems.

Agronomic practice like plant population is known to affect crop environment, which influence the yield and yield components. Optimum population levels should be maintained to exploit maximum natural resources such as nutrient, sunlight, soil moisture and to ensure satisfactory yield (Sharifi *et al*., 2009). If plant population is lower than optimum, then per hectare production will be low and weeds will also be more (Allard, 1999). Plant population plays an important role in pigeonpea production and its response to varied population levels due to its elastic nature in adjusting to different spacing. The low productivity of pigeonpea has been attributed to the fact that large area is under rainfed situation grown in wider spacing. Under such situation, other leguminous crops such as greengram can be grown as an intercrop to increase the productivity of the system. Keeping the aforesaid issues the study was performed to outbreak the effect of intercrop and different palnting geometry on pigeonpea.

Materials and Methods

Pigeonpea variety Co 6 was used as main crop for this study . Pigeonpea was intercropped with greengram COGG 973. The seeds were purchased from the Department of Pulses, TNAU, Coimbatore. The treatment consists of pigeonpea and greengram intercropping system under ridges and furrows land configuration. The experiment was laid out in randomized block design with twelve treatment combinations in three replications. The treatments comprised of planting geometry (row spacing of 90, 120, 150 and 180 cm at varied level of plant to plant spacing with 30, 45, and 60 cm) and different row proportions of pigeonpea + greengram (1:2, 1:3, 1:4 and 1:5).

The seeds were dibbled manually at different spacings as per the treatment schedule. As an intercrop, greengram with a spacing of 30 x 10 cm was raised as per the

treatments. Adjacent to the treatment plots, sole pigeonpea and greengram were also raised in dummy plots with same management practices to calculate the yield advantages**.** Five plants in each treatment in the net plot area were selected at random and tagged for observing the plant height, branches per plant, yield attributing characters viz. pods per plant, pod length, and seeds per pod and yield were recorded. The data were analyzed statistically following the procedure given by Gomez and Gomez (1984). Critical differences were worked out at five per cent probability level wherever the treatments were significant. The treatment differences that were non-significant were denoted as NS.

Results and Discussion

Performance of pigenope)

The plant growth characters are largely genetically controlled, and also it can be altered agronomically by wangling the crop environment and management factors. Growth attributes are the reflective process of effective utilization of resources in a better crop production environment. Sharifi *et al*. (2009) had noted that when plant population is too high, it encourages inter plant competition for resources ,and consequently, the net photosynthesis would be affected due to less light penetration in the crop canopy as well as increase in the competition for available nutrient resulting in poor growth of the plants.

An increasing trend was noticed in plant height from closer to wider geometry to certain level then it was decreased and higher plant height was observed in 1:3 row proportion. This may be due to the competition between inter and intra row plants for the resources and space which encouraged vertical growth rather than horizontal growth. Same outcome was reported by Darshan (2008) in pigeonpea + sesame @ 1:3 ratio. The shortest plants (1:5 row ratio) were due to depletion of nutrients from those plots over time because of competitive interaction, hence plants showed stunted growth owing to inadequate supply of nutrients. This finding was consonance with Pujari and Sheelavantar (1998) in pigeonpea intercrops @ 1: 2 row ratio (Table 1).

Similarly, this same 1:3 row proportion recorded significantly higher number of branches per plant compared to other intercropping treatments. The response of branch number to population density was linear. This result is in conformity with Vishwanatha *et al.* (2011) in pigeonpea + sunflower. But, on contrary to Srinivasulu *et al.* (2000) reported in black gram + sesame. Photosynthates supply to stem was reduced under high plant population. Stem diameter increased sharply with the low plant population.

DMP was found to be more (6342 kg/ha) in 1:3 row proportions with the wider spacing of 120 x 30 cm which could be attributed to optimum population and accumulation of nutrients unit area^{-1} compared to other row ratios. Owing to increased intra species competition mainly for light may be due to depletion of carbon dioxide by the component crop which rapidly declines the photosynthesizing ability of component crop that leads to lower dry matter accumulation in inter cropping system which leads to lower dry matter production (1935 kg/ha) of pigeonpea in 1:5 row ratio (Table 1).

The data shows that least significant differences with respect to stem girth at all the stages. Pigeonpea (120 x 30 cm) + greengram with 1:3 row ratio (T_4), had significantly higher stem girth (1.5, 3.5, 5.9, 7.9 cm at 30, 60, 90 and at harvest, respectively) which was on par with pigeonpea (120 x 45 cm) + greengram with 1:3 (T_5) and pigeonpea (90 x 60 cm) + greengram with 1:2 ratio (T_3). Lower stem girth was observed in pigeonpea (90 x 30 cm) + greengram with 1:2 ratio (T_1) and which was on par with pigeonpea (90 x 45 cm) + greengram in with same row ratio (T_2).

Table 1 Effect of planting geometry and row proportions of pigeonpea + greengram intercropping system on growth parameters of pigeonpea

Treatments	Plant height (cm)	Number of branches	Stem girth (cm)	Leaf Area Index	Dry matter production (kg ha^{-1})
T_1- Pigeonpea (90 x 30 cm) + Greengram (1:2)	190.5	21.5	5.3	1.61	4160
T_2- Pigeonpea (90 x 45 cm) + Greengram (1:2)	191.4	21.6	5.9	1.64	4347
T_3- Pigeonpea (90 x 60 cm) + Greengram (1:2)	192.3	22.5	7.6	1.78	4788
T_4- Pigeonpea (120 x 30 cm) + Greengram (1:3)	192.1	23.3	7.9	2.00	6342
T_5- Pigeonpea (120 x 45 cm) + Greengram (1:3)	191.5	22.7	7.8	1.78	5078
T_6- Pigeonpea (120 x 60 cm) + Greengram (1:3)	185.3	21.5	7.4	1.68	3916
T_7- Pigeonpea (150 x 30 cm) + Greengram (1:4)	185.5	22.3	7.2	1.66	4211
T_8- Pigeonpea (150 x 45 cm) + Greengram (1:4)	181.3	21.7	7.4	1.49	3279
T_9- Pigeonpea (150 x 60 cm) + Greengram (1:4)	180.6	21.5	7.4	1.21	2295
T_{10}- Pigeonpea (180 x 30 cm) + Greengram (1:5)	183.5	22.1	6.7	1.14	3142
T_{11}- Pigeonpea (180 x 45 cm) + Greengram (1:5)	173.8	22.4	7.3	1.01	2492
T_{12}- Pigeonpea (180 x 60 cm) + Greengram (1:5)	170.7	22.6	7.5	1.00	1935
SEd	6.85	0.56	0.70	0.039	184.8
CD (P=0.05)	14.30	1.16	1.45	0.081	383.3

Performance of greengram

Higher plant height obtained in greengram is due to balanced supply of nutrients. In cropping systems, maximum plant height was recorded in plots having 1:5 ratio. Lower plant height was ascribed to shading effect of pigeonpea on greengram due to differential plant architecture (Table 2).

The lower dry matter production was subjected to 1:3 and 1:2 row proportions. The lower dry matter production in intercropped greengram could be mainly attributed to the fact that pigeonpea plants covered that intercrops because of lower space between two pairs of pigeonpea and increased total population of pigeonpea per unit area resulting in increased competition for growth resources, specially the water, nutrients, light and CO_2 or space. This restricts the development of leaf area and thereby producing lower dry matter. This finding was in coincidence with the result of Pujari and Sheelvantar (2002) in pigeonpea + greengram intercropping system (Table 2)

Table 2 Effect of planting geometry and row proportions of pigeonpea + greengram intercropping system on growth parameters of greengram

Treatments	Plant height (cm)	Dry matter production (kg ha^{-1})	Leaf area index
T_1- Pigeonpea (90 x 30 cm) + Greengram (1:2)	54.1	2524	1.03
T_2- Pigeonpea (90 x 45 cm) + Greengram (1:2)	55.1	2580	1.34
T_3- Pigeonpea (90 x 60 cm) + Greengram (1:2)	61.3	2768	2.32
T_4- Pigeonpea (120 x 30 cm) + Greengram (1:3)	62.1	2788	2.48
T_5- Pigeonpea (120 x 45 cm) + Greengram (1:3)	61.6	2779	2.44
T_6- Pigeonpea (120 x 60 cm) + Greengram (1:3)	59.5	2740	1.86
T_7- Pigeonpea (150 x 30 cm) + Greengram (1:4)	55.9	2685	2.14
T_8- Pigeonpea (150 x 45 cm) + Greengram (1:4)	60.8	2628	2.01
T_9- Pigeonpea (150 x 60 cm) + Greengram (1:4)	59.9	2804	2.06
T_{10}- Pigeonpea (180 x 30 cm) + Greengram (1:5)	63.1	2822	2.65
T_{11}- Pigeonpea (180 x 45 cm) + Greengram (1:5)	62.7	2804	3.17
T_{12}- Pigeonpea (180 x 60 cm) + Greengram (1:5)	63.0	2873	3.56

SEd	2.83	101.1	0.123
CD (P=0.05)	5.87	211.2	0.254

The photosynthetic activity is dependent on the photosynthetic apparatus, leaf area and leaf area index and nutrient supply etc. In the present investigation, highest leaf area index of greengram was recorded in the intercropped pigeonpea + greengram (1:5) system, which supported the growth and growth components effectively (Table 2).

Conclusion

On the basis of agronomic as well as economic performance, pigeonpea (120 x 30 cm) + greengram intercropping in 1:3 row proportion under ridges and furrows land configuration proved to be more productive and remunerative and this salient finding will be useful for pigeonpea growers to enhance income under irrigated conditions.

Authors' contributions: Udhaya Nandhini Dhandayuthapani (Ph.D. Research Scholar) performed the research experiment, wrote the manuscript and is the corresponding author of manuscript. Vimalendran Loganathan (Research Scholar) was responsible for data collection and editing of measurement. K.R. Latha, (Professor and Project leader) contributed to editing, correction of manuscript and overall guidance.

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