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System of Crop Intensification (SCI) Techniques on Yield and Economics of Greengram

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Abstract: *Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore, during Rabi (Oct- Jan) season, 2010-2011 to evaluate the influence of System of Crop Intensification (SCI) practices in greengram. The experiment was laid out in Randomized complete block design comprised of nine treatments. The treatments were replicated thrice. Yield attributes like number of clusters hill^{-1} (7.67) and number of pods hill^{-1} (38.00) was significantly higher with double seedlings hill^{-1} maintained at 40 x 40 cm planting geometry (T_8) than other levels. Whereas, pod length and 100 grain weight were not altered due to SCI practices. Double seedling hill^{-1} maintained at 20 x 20 cm spacing (T_5) registered significantly higher grain yield (1263 kg ha^{-1}) and it was on par with single seedling hill^{-1} maintained at 25 x 25 cm spacing (1207 kg ha^{-1}), single seedling hill^{-1} with 25 x 25 cm spacing (1207 kg ha^{-1}) and double seedlings with 30 x 30 cm (1117 kg ha^{-1}). Haulm yield was higher under double seedlings hill^{-1} with 30 x 10 cm spacing (2746 kg ha^{-1}). The highest net return (₹16371) and B: C ratio (1.76) were obtained with double seedlings hill^{-1} maintained at 20x 20 cm spacing (T_5). Hence, it is concluded that under SCI in greengram (variety CO 6) raised at 20 x 20 cm spacing with double seedlings proved to be a better option for getting higher productivity and profit under garden land condition of Western zone of Tamil Nadu.*

Keywords: *Greengram, Number of seedlings hill^{-1}, Crop geometry, Growth attributes, Grain yield, Economic returns*

I. Ntroduction

The System of Rice Intensification (SRI), developed in Madagascar in the 1980s, has proved to be one of the most important recent agricultural innovations which had been spreading across farmers' fields. SRI is a promising rural innovation that has been developed outside of the formal research system. It modifies conventional practices of paddy cultivation by managing plant, water, soil and nutrient in more effective ways, which raise the productivity of available land, labor, water, and energy and enhance food security for vulnerable farming communities. The SRI has set of principles such as use of young seedlings, one seedling hill^{-1}, square planting, mechanical weeding, intermittent wetting and drying and addition of organic matter (Makarim *et al*. 1994). By adopting these principles the production of rice has been reported to increase from 50 to 100 per cent (Uphoff 2002). In the recent, the successful SRI practices are being extrapolated to other crops such as wheat, Teff grass, maize, sorghum, finger millet, soybean, blackgram, kidney bean, lentil, mustard, sugarcane, tomato, brinjal, chilli, potato, carrot and onion in the name of System of Crop Intensification (SCI) (ISD, 2009). Similar to SRI, the SCI practices also proved to increase the yield levels of crops more than two times (Uphoff *et al*. 2011). In pursuit of extending the beneficial effect of SCI, the present study was programmed in greengram. Adoption of SCI practices in greengram may enhance the productivity and reduce the gap between per capita availability and consumption and in turn possible to contribute to nutritional security of the country. Therefore, a field experiment was conducted to evaluate the suitability and economic viability of System of Crop Intensification methodology in green gram.

II. Materials And Methods

Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore (11°N and 77°E longitude; 426.7 m above mean sea level) during winter (Oct- Jan) season of 2010-11. The experimental soil was sandy clay loamy in nature, texture belonging to *Typic Haplustalf*. The pH of the soils was 8.15, EC was 0.38 dSm^{-1}, organic carbon was 0.22% and available N, P and K were 190 kg N ha^{-1}, 9.6 kg P ha^{-1}, 704.2 kg K ha^{-1} during *Rabi* season. The experiment was laid out in a Randomized Complete Block Design with three replications. The experiment consisted of nine treatments *viz*., T_1 - Single seedling hill^{-1} + 20 x 20 cm, T_2 - Single seedling hill^{-1} + 25 x 25 cm, T_3 - Single seedling hill^{-1} + 30 x 30 cm, T_4 - Single seedling hill^{-1} + 40 x 40 cm, T_5 - Double seedlings hill^{-1} + 20 x 20 cm, T_6 - Double seedlings hill^{-1} + 25 x 25 cm, T_7 - Double seedlings hill^{-1} + 30 x 30 cm, T_8 - Double seedlings hill^{-1} + 40 x 40 cm and T_9 - Control (30 x 10 cm + two seedlings hill^{-1} + one herbicide + one hand weeding). One hand weeding (35 DAS) was practiced for T_1 to T_8 treatments. Greengram variety 'CO 6' with a germination percentage of 95 was selected for the study. The recommended fertilizer schedule for the crop i.e. 25 kg N + 50 kg P + 25 K ha^{-1} were applied as basal through urea, diammonium phosphate (DAP) and muriate of potash (MOP), respectively. Farmyard manure was applied @ 12.5 t ha^{-1} just before last harrowing and incorporated by harrowing. Adequate plant protection measures and irrigation were given as per the requirement. All other recommended package of practices was followed to raise the crop as per Crop Production Guide (2005). Five plants were selected randomly from each treatment and observations were made on growth (Plant height, Dry matter production, Leaf area index (LAI)) and yield parameters (Number of clusters hill $^{-1}$, Number of pods hill $^{-1}$, Number of seeds pod^{-1}, Test weight, Grain yield). The yield parameters were recorded at the time of harvest in each treatment. The data were subjected to statistical analysis of Gomez and Gomez (2010). In general, differences are reported 5% probability level. Cost of cultivation, Gross return, Net return, Benefit cost ratio (B: C ratio) were worked out for green gram.

III. Results And Discussion

The result of the field experiment investigate the effect of crop geometry and number of seeds under SCI method on yield attributes are presented in the chapter.

Yield and yield attributes

The yield attributes and yield of greengram has significantly affected due to the number of seedlings hill^{-1} and crop geometry (Table 1). There was no significant difference in length of pod, number of seeds pod^{-1} and 100 grain weight. Double seedlings maintained at 40 x 40 cm (T_8) recorded higher number of clusters hill^{-1} (7.67), whereas, it was statistically on par with double seedlings maintained at 30 x 30 cm spacing T_7 (6.47). Control with double seedlings at 30 x 10 cm (T_9) spacing registered significantly lower number of clusters hill^{-1} (5.33) compared to other double seedlings treatments. Decrease in number of clusters hill^{-1} was under closer spacing due to mortality caused by mutual shading during pre flowering stage of the crop. Similar findings were also reported by Subramani *et al.* (2002) in blackgram and Siddaraju *et al.* (2010) in cluster bean.

Double seedlings with 40 x 40 cm spacing (T_8) recorded higher number of pods hill^{-1} (38), it was followed by double seedlings maintained at 20 x 20 cm, T_6, T_7 and T_9. The least number of pods hill^{-1} (18.0) was observed with single seedling maintained at 20 x 20 cm spacing (T_1). The increase in number of pods hill^{-1} at wider crop geometry was due to better crop growth, more space available for plants, lesser competition for moisture and nutrients between plants. This is in conformity with the findings of Subramani *et al.* (2002); and Bhairappanavar *et al.* (2005) in blackgram, Goyal *et al.* (2010); and Siddaraju *et al.* (2010) in cluster bean.

The higher grain yield of greengram (1263 kg ha^{-1}) was recorded with double seedlings maintained at 20 x 20 cm followed by T_2 (1207 kg ha^{-1}) than all other SCI practices and control (T_9), whereas it was comparable with T_6 (1187 kg ha^{-1}), T_1 (1157 kg ha^{-1}) and T_7 (1117 kg ha^{-1}). The percentage yield increase due to T_5 over control was 20. Optimum spacing would have effectively utilized the growth resources, particularly solar radiation as compared to narrow spacing, where plants might have suffered due to mutual shading in case of adjoining rows and more plants. It is corroborating with findings of Singh and Verma (1999); and Singh *et al.* (2009a) in lentil. T_4 recorded noticeably the lowest grain yield (617 kg ha^{-1}) with single seedlings hill^{-1} at wider spacing (40 x 40 cm). The lower plant density might have reduced the grain yield.

Table 1. Influence of System of Crop Intensification (SCI) practices on yield of greengram

Treatments	No. of clusters hill^{-1}	Length of pod (cm)	No. of pods hill^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index
T_1 - Single seedling + 20 x 20 cm	3.80	7.33	25	11.0	3.3	1157	1877	0.31
T_2 - Single seedling + 25 x 25 cm	4.10	7.33	31	12.3	3.4	1207	1453	0.36
T_3 - Single seedling + 30 x 30 cm	4.17	7.17	26	12.0	3.3	1027	1332	0.33
T_4 - Single seedling + 40 x 40 cm	4.80	7.23	27	12.0	3.3	617	1163	0.24
T_5 - Double seedlings + 20 x 20 cm	6.27	7.40	37	12.3	3.4	1263	1309	0.31
T_6 - Double seedlings + 25 x 25 cm	6.40	7.53	37	11.7	3.3	1187	2014	0.31
T_7 - Double seedlings + 30 x 30 cm	6.47	7.43	37	12.0	3.4	1117	1447	0.33
T_8 - Double seedlings + 40 x 40 cm	7.67	7.21	38	11.7	3.3	753	1355	0.24
T_9 - Control (2 seedlings + 30 x 10 cm)	5.33	7.20	35	10.7	3.4	1050	2746	0.24
SE. d	**0.54**	**0.32**	**0.97**	**1.15**	**0.33**	**94**	**38**	**0.03**
CD (P=0.05)	**1.15**	**0.67**	**2.07**	**2.43**	**0.70**	**199**	**80**	**0.06**

Haulm yield (2746 kg ha^{-1}) was higher under double seedlings hill^{-1} at 30 x 10 cm compared to others, might be due to more population unit area^{-1}. This would have contributed to more biomass and hence higher haulm yield. This was also documented earlier by Sathyamoorthi *et al.* (2008) in greengram. Harvest index (0.36) was higher under medium spacing (25 x 25 cm) with single seedling hill^{-1} than other spacing levels which was on par with T_3 and T_7 (0.33). The increase in grain yield ultimately leads to higher harvest index. Similar findings were also reported by Shukla and Dixit (1996) in greengram and Siddaraju *et al.* (2010) in cluster bean. The lowest harvest index (1.63) was recorded under closer spacing (30 x 10 cm) with double seedlings hill^{-1} due to more haulm yield. This indicates that not much of the photosynthate was partitioned to main economic parts to make significant contribution to seed yield. This is in agreement with the findings of Agugo *et al.* (2010) in greengram.

Economic returns

The highest cost of cultivation (₹ 21747 ha^{-1}) was accounted with double seedlings at 30 x 10 cm spacing (Table 3). Higher grain productivity with 20 x 20 cm increased the gross (₹ 37900 ha^{-1}) and net returns (₹ 16371 ha^{-1}). Benefit cost ratio was also higher with double seedlings maintained at 20 x 20 cm (T_5) (1.76), it was closely followed by single seedling with 25 x 25 cm spacing (T_2) and T_6. The maximum net return and B: C ratio were observed under medium spacing (20 x 20 cm) with double seedling hill^{-1} than other levels.

Data statistically not analyzed This might be due to the fact that greengram has utilized the resources available below and above the ground very effectively thereby exhibited better growth and yield parameters.

This result is supported by the findings of Singh *et al.* (2009b) in blackgram and Tomer *et al*. (1993) in greengram and blackgram.

Table 2. Effect of crop geometry and number of seedlings on economics of greengram

Treatments	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C Ratio
T_1 - Single seedling + 20 x 20 cm	21377	34700	13323	1.62
T_2 - Single seedling + 25 x 25 cm	20928	36200	15272	1.73
T_3 - Single seedling + 30 x 30 cm	20373	30800	10427	1.51
T_4 - Single seedling + 40 x 40 cm	20077	21450	1373	1.07
T_5 - Double seedlings + 20 x 20 cm	21529	37900	16371	1.76
T_6 - Double seedlings + 25 x 25 cm	21028	35600	14572	1.69
T_7 - Double seedlings + 30 x 30 cm	20988	33500	12512	1.60
T_8 - Double seedlings + 40 x 40 cm	20826	23200	2374	1.11
T_9 - Control (2 seedlings + 30 x 10 cm)	21747	31500	9753	1.45

From the experimental results obtained over field investigation, it could be enlightened that greengram with double seedlings maintained at 20 x 20 cm along with rotary weeding on 20 DAS and one hand weeding on 35 DAS produced better yield characters and yield besides being economically competitive and productive. Hence, it is concluded that under SCI in greengram (variety CO 6) raised at 20 x 20 cm spacing with double seedlings proved to be a better option for getting higher productivity and profit under garden land condition of Western zone of Tamil Nadu.

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