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WEED CONTROL EFFICIENCY PRODUCTIVITY AND ECONOMICS OF CHICKPEA INFLUENCED BY PLANTING GEOMETRY UNDER NEW ALLUVIAL ZONE OF WEST BENGAL INDIA

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ABSTRACT

A field experiment was conducted during *rabi* season of 2020-2021 and 2021-22 at District Seed Farm (AB Block), Bidhan Chandra Krishi Viswavidyalaya to study the consequences of varied planting geometry for crop-weed interventions in Chickpea (*Cicer areitinum* L.) under new alluvial zone of West Bengal. The treatment consisted with three inter row spacing (30 cm, 40 cm and 50 cm) combined with five intra-row spacing (10 cm, 20 cm, 30 cm, 40 cm and 50 cm). The experiment was laid out in Randomized Block Design with twelve treatments with each treatment replicated thrice. Planting geometry with various combinations of inter- and intra- row spacing had significant effect on growth, yield, weed control and economics of chickpea cultivation. The highest plant height (70.17 cm) and plant population (31.66 m^{-2}) was achieved from the treatment with 30 cm inter- and 10 cm intra- row spacing. Wider spacing of 50 cm inter- row and 50 cm intra- row showed significantly highest number of primary branches per plant (5.47), secondary branches per plant (14.83), number of pods plant^{-1} (91.98), number of seeds pod^{-1} (1.33) and seed weight (15.37 g.). Significantly the highest (1500.70 kg ha^{-1}) seed yield was obtained with 30 cm inter- and 10 cm intra- row spacing where the lowest (709.65 kg ha^{-1}) seed yield was found in 50 cm inter- and 50 cm intra-row spacing. Following the same result treatment combination with 30 cm inter- and 10 cm intra-row spacing had significantly highest weed control efficiency (63.63%) over others. Lowest Weed Index (9.98%) was found in 40 cm inter- and 10 cm intra-row spacing and highest (52.71%) with 50 cm inter- and 50 cm intra- row spacing respectively. Highest benefit-cost ratio (2.45) was achieved from the treatment with 30 cm inter- and 10 cm intra-row spacing. Thus, 30 cm inter- and 10 cm intra- row spacing can be recommended for chickpea production.
***Keywords* :** Chickpea, row spacing, yield, weed efficiency, weed index, economics.

Introduction

Chickpea (*Cicer arietinum* L.) is one of the earliest and commonly cultivated pulse crops of India. Chickpea is an important grain legume in the World and ranked third after common bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativum* L.) (FAO, 2019). In India chickpea cultivation was not so popular due to its stagnant productivity and lack of improved production technology. Thus, subsidized staple grains are always been a choice over the nutrition for the people. According to Directorate of Economics & Statistics, DAC&FW (2018-19) chickpea cultivated on 9.44 million ha, yielding 10.3 million tonnes of grain each year. In West Bengal, chick pea is grown in 26177 ha and total production is 30844 MT. Nadia is leading district in chickpea production with 9906 ha (Roy *et al.*, 2016-17). Chickpea is very vulnerable to weed competition due to its early slow growth and short stature and significant yield losses of up to 75% (Chaudhary *et al.*, 2005) can occur if weed growth is not controlled in time. Chickpeas are not a competitive crop, especially when weed competition develops early in the growing season and (Barker, 2017). Weed-related yield losses in chickpeas have been reported to be between 40 and 87 percent in India, 41 to 42 percent in the former Soviet Union (USSR), and 23 to 54 percent in West Asia (Bhan and Kukula, 1987). However, over the years, losses due to weed in chickpea ranged from 29 to 70% at the Indian Institute of Pulses Research (Anonymous, 2009). Weed-related losses could include increased harvest costs and lower crop quality (Miller *et al*., 2002). The most important weeds that infest the chickpea crop under irrigated conditions are *Anagallis arvensis L., Lathyrus aphaca L., Convolvulus arvensis L., Cyperus rotundus L., Fumaria indica., Cynodon dactylon (L.)., Croton bonplandianum. , Solanum xanthocarpum., Medicago lupulina., Cynodon dactylon., Launaca nudicaulis., Physalis minima., Echinochloa colona., Blumea lacera., Vicia hirsuta., Vicia sativa., Cucumis melo., Xanthium strumarium, Anagalis arvensis., Fumarica parviflora., Cyperus rotundus., Parthenium hysterophorus., Melilotus indica, Cirsium arvense.*

An appropriate planting layout would enable a crop to exert more interspecific competition, minimise losses from weeds, and make better use of the resources already available, such as soil moisture and nutrients (Zimdahl, 1980). With these facts in mind, the current study was conducted to determine how crop-weed competition in chickpea is affected by row spacing, and weed-management techniques.

Materials and Methods

The experiment was conducted during *rabi* season of 2020-2021 and 2021-22 at District Seed Farm (AB Block), Bidhan Chandra Krishi Viswavidyalaya, West Bengal in Alluvial soil. The farm was situated at 22º 98' N latitude and 88 º425' E longitude with an average altitude of 7˙8 m above mean sea level under humid region of West Bengal. The soil of the experimental field was sandy loam in texture, well drained with low level of organic carbon (0.62%), available Nitrogen (232.7 kg ha^{-1}), Phosphorus (14.2 kg ha^{-1}) and Potassium (186.2 kg ha^{-1}) content. The soil is neutral (pH 6.6) in reaction. The experiment was laid out in Randomized Block Design (RBD), consisting of twelve treatments *viz*. combination of varying inter-row spacing of 30 cm, 40 cm and 50 cm combined with its lowest to equal of each highest intra-row spacing ranges from 10 cm, 20 cm, 30 cm, 40 cm and 50 cm respectively. In all twelve treatments were replicated thrice. Chickpea crop variety of GNG 2299 was sown on 22nd November during 2020-21 and 15th November during 2021-2022 as test crop in the experiment. The recommended package of practices was followed for raising the crop. Different types of weeds like grasses, sedges and broad leaves was observed and studied during the experiment. The analyses of variance method as described by Cochran and Cox (1977) was followed for statistical analyses of the observed experimental data. The significance of different sources of variation was tested by "Error mean square method" following Fisher-Snedecor's F-test at probability level of 0˙05.

Chickpea seed was inoculated with Rhizobium culture @ 20gm/kg of seed. Crop was raised by applying 20 kg N ha^{-1} and 40 kg P_2O_5. The crop was harvested manually. The data on yield attributes and seed yield were recorded and analyzed statistically. In each plot, 2 spots were randomly selected for recording the data on weed density and dry matter accumulation 30,60 DAS and at harvest, using quadrate measuring 0.25 m^2. The weeds were counted and removed for recording their biomass. Weed samples were initially sun-dried and then dried in an oven at temperature of 60 oC until constant weight was attained. The data on weeds were subjected to square-root transformation before statistical analysis. The weed control efficiency (WCE) was calculated as:

$$WCE = \frac{X - Y}{X} \times 100$$

Weed index (WI) of different treatments was calculated based on the reduction in grain yield of a particular treatment in comparison with yield obtained from weed-free treatment. It was calculated by the formula:

$$WI = \frac{Y_{CO} - Y_t}{Y_{CO}} \times 100$$

Harvest index was calculated from the seed yield and stover yield of chickpea for each plot and expressed in percentage.

Harvest Index (%) = Economic yield (t ha^{-1}) /Biological yield (t ha^{-1}) × 100.

The yield parameters listed below were investigated using a sample taken for biomass observation at the time of harvest. The total numbers of pods on five randomly chosen plants were counted, and the average number of pod plant-1 was calculated. The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by Gomez and Gomez (1984). The level of significance used for 'F' and 't' tests was p=0.05. Critical Difference (CD) values were calculated at 5% probability level if the F test will find to be significant.

Results and Discussion

The treatment combination of different crop geometry responds significantly towards plant height in all growth stages in chickpea. The highest plant height was recorded in the combination of 30 cm inter and 10 cm intra- row (70.17 cm) while plant population per square metre was observed at its highest of 31.66 which followed by 40 cm (68.33 cm and 23.66 m^{-2}) and 50 cm(66.43 cm and 18.55 m^{-2}) inter-row with the same intra-row spacing respectively. Plant height and plant population simultaneously decreases with the increase in inter-row spacing as well as intra-row spacing and yielded lowest value in 50 cm inter row with combination of 50 cm intra-row spacing (53.71 cm and 3.44 m^{-2}) which at par with 40 cm intra-row spacing (53.39 and 4.33 m^{-2}). That result implies the fact that with the variation of crop spacing plant density was varied accordingly and higher plant density occurred by the close spacing exposed to competition among the plants for light interception which encourage vertical elongation stem. Another study reported that the plant height, number of nodes and leaf area was increased with the decreasing plant population (Jadoski, 2000).

Number of Primary and Secondary branches per plant was significantly varied with the different spacial arrangements. Highest number of both type of branches i.e. Primary and Secondary was observed under a wide spacing of 50 cm inter row with combination of both 40 cm (5.47 and 14.61) and 50 cm intra row spacing (5.40 and 14.83) respectively. Lowest value of both primary and secondary branches was observed in narrow spacing with the combination of 30 cm inter and 10 cm intra row spacing (3.13 and 10.63). Similar result was found by Basha *et al.* (2018) where significantly higher number of branches (8.8) was observed under 30 cm X 10 cm with 33 plants m^{-2} compared to 22.5 cm X 10 cm (7.7) with 44 plants m^{-2}. Reason behind the trend was in increasing spacing plants exposed to higher light interception, water and nutrients from the soil faced less competition compared to densely populated area and resulted higher numbers of primary and secondary branches per plant.

Result of the experiment was found that with increasing spacing number of pods per plant was increased significantly. Treatment combination of 50 cm inters and 50 cm intra row spacing yielded highest number of pods per plant (91.98). Lowest number of pods per plant was observed in 30 cm inter and 10 cm intra row spacing (33.00). This is due to the reason of increasing plant spacing promoted higher number of branching as well as higher number of pods per plant. Khanna-Chopra and Sinha (1987) was established the fact that in case of dense population the production of flowers as well as pods apparently decreased because of competition for photosynthates between the vegetative parts and the developing reproductive sink.

Number of seeds per pod also showed a significant variation with the various spacing arrangements. Though the significance level is very narrow but the lowest number of pods per pod was seen in close spacing with 30 cm inter and 10 cm intra row (1.03). On the other hand opposite result was found with the combination of 50 cm inter and 50 cm intra row spacing (1.33). Similar result was found by Chala (2020) that the lowest number of seeds per pod (1.26) was recorded at 20 cm inter row with 5 cm intra row spacing i.e., seeds per pod was increased with decreased plant density (wider spacing) of Chickpea.

Seed weight per plant was also significantly varied with the different row arrangement. Highest seed weight was recorded with 50 cm inter and 50 cm intra row spacing (15.37) and lowest seed weight was with the spacing of 30 cm inter and 10 cm intra row spacing (13.83). So, it can be concluded that the lower density along with the number of seeds per plant the seed weight also increased by lower competition among the plants. Matthews *et al.* (2006) reported the same that seed weight per plant decreased significantly as plant density increased.

Seed yield with higher population in narrow spacing was subsequently superior and significantly varied from lower populated field with wider spacing. Highest seed yield was recorded with the treatment of 30 cm inter and 10 cm intra row spacing (1500.70) followed by same intra spacing i.e., 10 cm with 40 cm (1350.86) and subsequently 50 cm (1165.53) inter row spacing. Lowest yield was recorded with wider spacing of 50 cm inter and 50 cm (709.65) intra row. Though the number of branches carried highest number of pods per plant as well as seeds per pod and increasing seed weight in wider spacing but due to less number of plants per square meter the overall lower seed yield was found. On the other hands in narrow spacing crop density is higher i.e., plant population per unit area was higher which successfully overcome the deficit of other lower yield attributes to achieve higher yield. Thangwana and Ogola (2012) also found the same result and reported that grain yield was 108% greater at the high planting density (2149 kg ha^{-1}) compared with the low planting density (1035 kg ha^{-1}) and also grain yield was 70& greater at the high planting density compared with the medium planting density (1267 kg ha^{-1}).

Harvest Index was significantly varied according to different crop spacing and it was found that close spacing with 30 cm inter row and 10 cm intra row have highest value (33.24) over all other spacing. This was followed by 10 cm intra row spacing with combination of 40 cm (32.45) and 50 cm (30.50) intra row spacing respectively. The lowest value was recorded with the wider spacing at 50 cm inter and 50 cm intra row spacing (25.65). Khan *et al*. (2010) also reported the effect of planting pattern, plant density and their interactions on the seed yield and harvest index were significant. The seed weight and Harvest Index of plants in the planting pattern of twin row in this study was significantly more than in the single row.

Earlier it was shown that crop geometry had significant effect to control the weed growth. It was found that closer spacing nearly a weed free plot had highest weed control efficiency compared to the wider spacing. Here wider spacing was encouraged the highest weed growth and can be compared with weedy plot. Intra row spacing of 10 cm with the combination of 30 cm (63.63) followed by 40 cm (61.51) and 50 cm (57.46) inter row spacing respectively had more efficiency over the combination of 50 cm inter and 50 cm intra row spacing. Wider spacing of 50 cm inter row with the combination of 30 cm (20.20) and 40 (5.18) intra row spacing had very low efficiency to control weed. Tesadale and Frank (1983) found that closer row spacing suppressed weed effectively than wider row spacing in *Phaseolus vulgaris.*

Reduction of crop yield due to weed infestation was varied with the different crop spacing and calculated by Weed Index. Closer crop spacing of 30 cm inter and 10 cm intra row spacing yielded highest and considered as weed free plot compared to others flowed by 40 cm inter and 10 cm intra row spacing had higher weed index value (9.98) over the medium spacing treatments. Wider spacing with 50 cm inter and 50 cm intra row spacing had highest value of weed index (52.71) which implies the lowest yield due to the presence of weeds. Similarly, Wish *et al.* (2002) also reported that the chickpea yields from the crops sown in narrow rows (32 cm) were consistently higher than yields with wide row (64 cm) spacing under weed free conditions i.e., narrower row spacing considerably advanced the competitive ability of the crop as consequence of earlier canopy closure.

The highest return per rupee investment was studied and it was observed that narrow intra row spacing always had highest benefit than the others. So, 30 cm inter row reported the highest benefit cost ratio (2.45:1) over the 40 cm (2.21:1) followed by 50 cm (1.93:1) when combined with the same intra row spacing i.e., 10 cm. 30 cm intra row spacing with each of 30 cm (1.60:1) and 40 cm (1.44:1) followed by 50 cm (1.40:1) inter row had medium benefit-cost ratio over the wider spacing with 50 cm inter and 50 cm intra row spacing (1.21:1).

Conclusion

The study was revealed that the planting geometry with various combination of inter and intra row spacing had significant response on plant growth, plant population, yield as well as on weed suppression. The comparison between wider spacing versus narrower spacing can be a reflection of a farmer's field where broadcasting of a chickpea crop used to follow. Uneven distribution of seeds is the result of a fluctuating growth of the plant which followed by yield and subsequently encourages the weed germination that leads to low profit. On the other hand narrower intra row spacing was always having higher plant population density which naturally can be reduced the weed population by cutting down its cost for weed management. So, even of wider inter row spacing that should be combined with narrower intra row spacing always been recommended for the economic stability towards chickpea cultivation.

Table 1: Effect of different crop geometry on growth, yield, weed control efficiency, weed index and benefit-cost ratio of chickpea during 2020-21 and 2021-22; mean over two years.

Treatment	Plant height (cm)	No. of Primary branches /plant	No. of secondary branches /plant	No. of pods /plant	Seed weight (g.)	Seed Yield (kg/ha)	Harvest Index (%)	Weed Control Efficiency (%)	Weed Index (%)
T_1:30X10	70.17	3.13	10.63	33.00	13.83	1500.70	33.24	63.63	-
T_2:30X20	63.53	3.80	11.52	38.60	14.28	1011.55	29.15	52.27	32.59
T_3:30X30	59.79	4.30	12.27	48.48	14.50	957.15	28.33	40.02	36.22
T_4:40X10	68.33	3.33	10.92	35.28	14.21	1350.86	32.45	61.51	9.98
T_5:40X20	61.23	4.03	11.95	41.14	14.85	986.14	28.60	46.07	34.29
T_6:40X30	57.05	4.90	12.85	52.28	15.23	852.36	27.36	31.08	43.20
T_7:40X40	55.39	5.17	13.94	60.59	15.23	793.52	26.08	15.31	47.12
T_8:50X10	66.43	3.40	11.04	39.03	14.46	1165.53	30.50	57.46	22.33
T_9:50X20	59.34	4.60	12.54	47.26	15.13	915.86	27.63	37.03	38.97
T_{10}:50X30	55.77	5.03	13.39	60.92	15.24	827.31	26.75	20.20	44.87
T_{11}:50X40	53.39	5.40	14.61	74.03	15.34	731.63	25.92	5.18	51.25
T_{12}:50X50	53.71	5.47	14.83	91.98	15.37	709.65	25.65	-	52.71
S.Em (±)	1.63	0.23	0.26	0.94	0.08	37.10	0.78		
C.D. (P=0.05)	4.80	0.69	0.78	2.81	0.24	109.51	2.31		

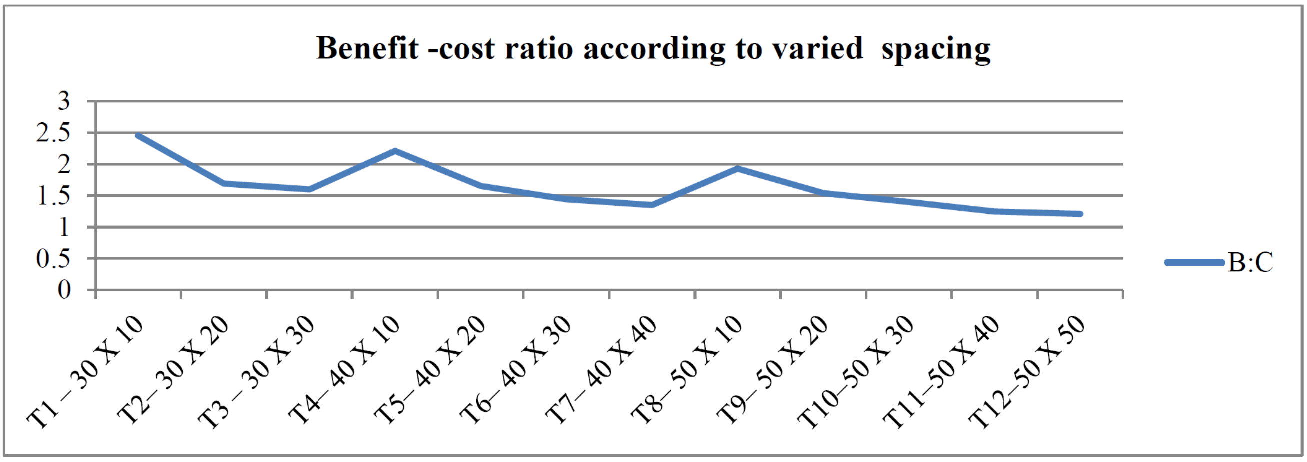

Fig. 1: Benefit–Cost Ratio According to Varied Spacing under

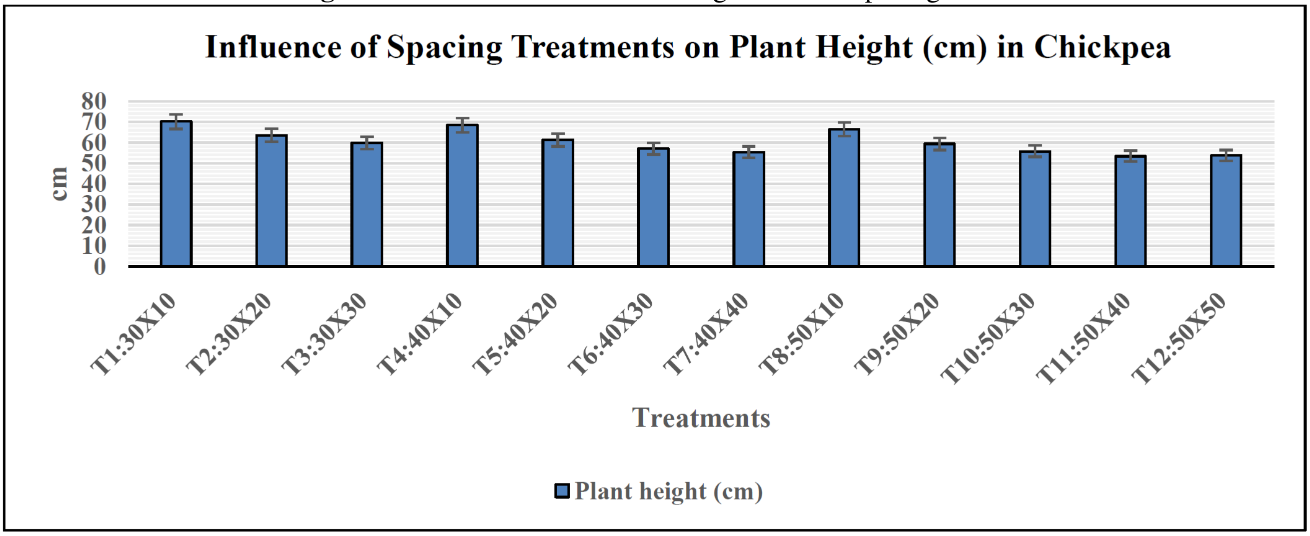

Fig. 2: Influence of Spacing Treatments on Plant Height (cm) in Chickpea

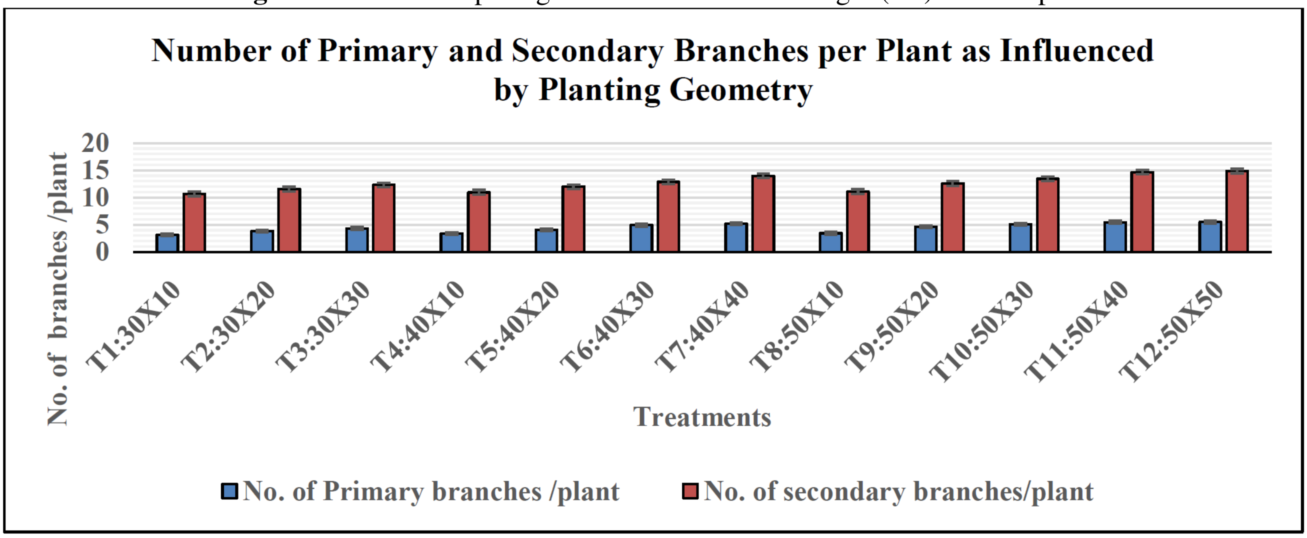

Fig. 3: Number of Primary and Secondary Branches per Plant as Influenced by Planting Geometry

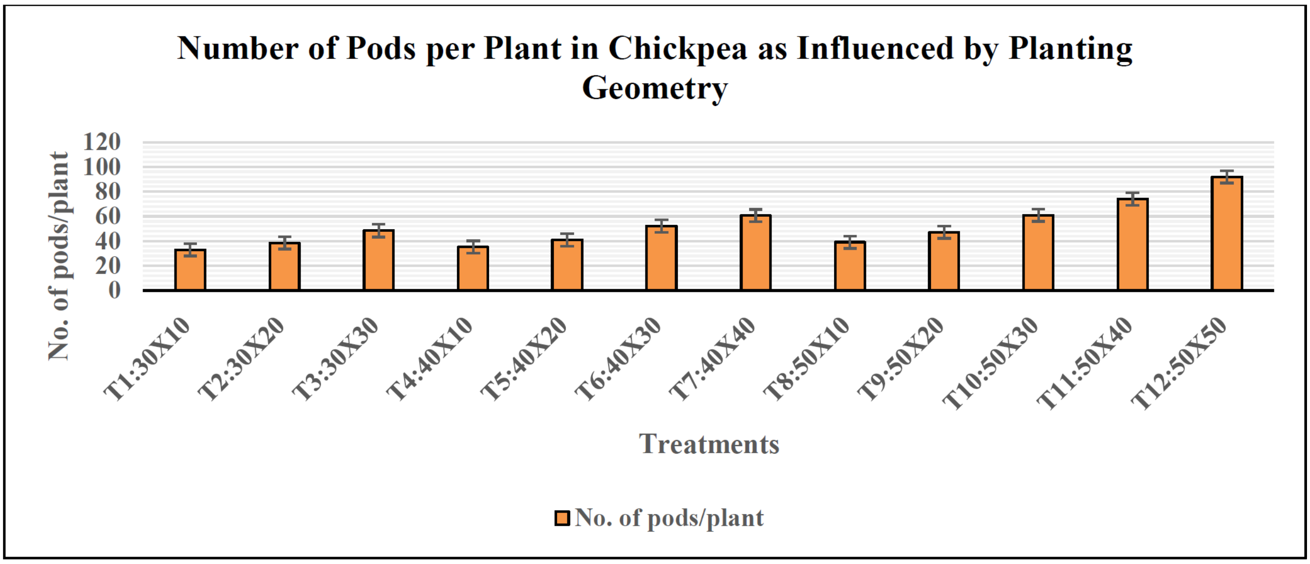

Fig. 4: Number of Pods per Plant in Chickpea as Influenced by Planting Geometry

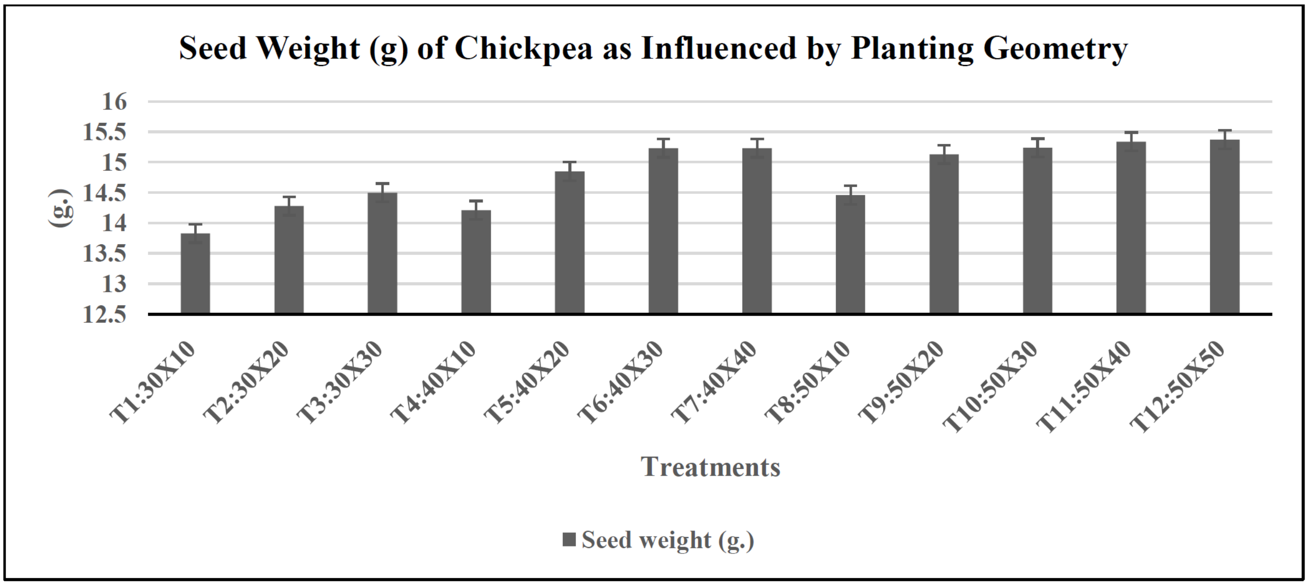

Fig. 5: Seed Weight (g) of Chickpea as Influenced by Planting Geometry

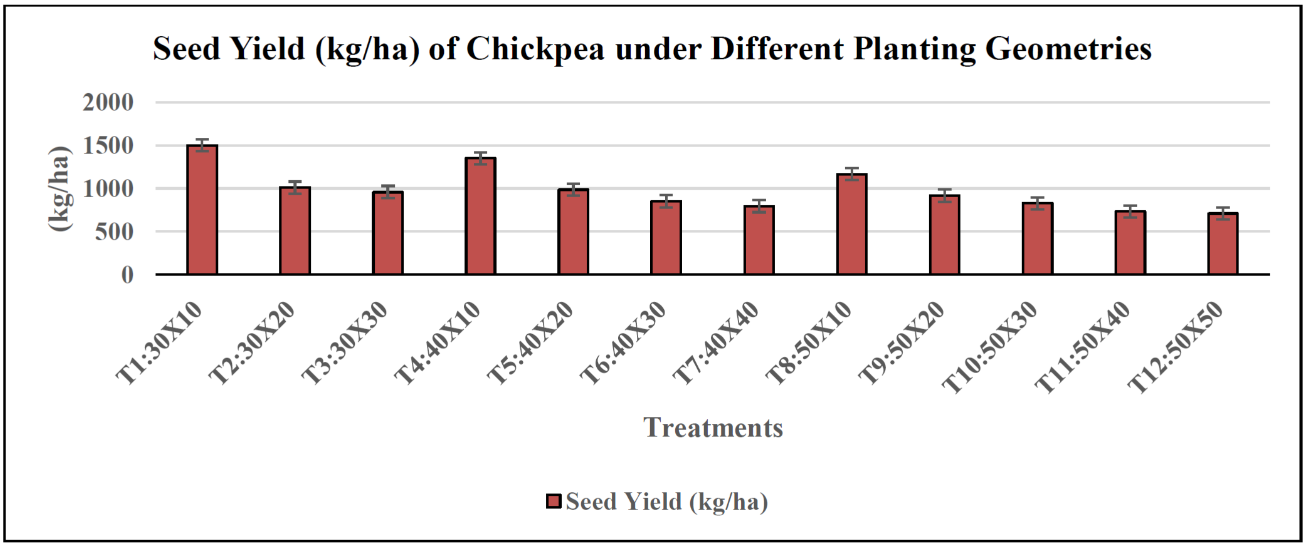

Fig. 6: Seed Yield (kg/ha) of Chickpea under Different Planting Geometries

References

Barker, B. (2017). Critical Weed Free Period of Pulses. Pulse Advisor. Saskatchewan Pulse Growers. pp. 1-3.

Basha, S.J., Lakshmi, V.J., Reddy, A.T., Kamakshi, N. and Ahammed, K. (2018). Estimate of growth and yield parameters of Chickpea (*Cicer arietinum* L.) cultivars amenable to mechanical harvesting. *Journal of Pharmacognosy and Phytochemistry*. **7**(5), 2089-2019

Bhan, V.M., Kukula, S. (1986). Weeds and their control in chickpea. In, The Chickpea (Eds. MC Saxena, KB Singh), CAB International, Wallingford, Oxon OX10 8DE, UK, pp. 319-329.

Chala, B., Abera, T. and Nandeshwar, B. (2020). Influence of inter and intra row spacing on yield and yield components of Chickpea (*Cicer arietinum* L) in Jimma Horro District, Western Ethiopia. *International Journal of Plant and Soil Science*. **32**(15), 32-42

Choudhary, B. M., Patel, J. J. and Delvadia, D. R. 2005. Effect of weed management practices and seed rates on weeds and yield of chickpea. Indian J. Weed Science. **37**(3-4), 271-272

Cochran, W.G. and Cox, G.M. 1977. Experimental Designs. *Asia Publishing House,* Calcutta. pp. 95-191.

Jadoski, S. O., Carlesso, R., Teresinha, M.,Woischick, P.D. and Cervo, L. (2000). Plant population and row spacing for irrigation dry bean. I, plant morphological characteristics. *Fitotecnia. Cienc Rural.***30** (4), 55-60

Khan, E.A., Aslam, M., Ahmad, H.K., Himayatullah, Khan, M.A. and Hussain, A. (2010). Effect of row spacing and seeding rates on growth, yield and yield components of Chickpea. *Sarhad Journal of Agriculture*. **26**(2), 201-211

Khanna-Chopra, R. and Sinha, S.K. (1987). Chickpea, physiological aspects of growth and yield, In, *M.C. Saxena and K.B. Singh (eds.), The chickpea. CAB International,* Wallingford, UK, p. 163-189.

Matthews, P.W., Armstrong, E.L., Lisle, C.J., Menz, I.D., Shephard, P.L. and Armstrong, B.C. (2008). The effect of Faba bean plant population on yield, seed quality and plant acchitecture under irrigation in Southern NSW. *Proceedings of the 14th Australian Agronomy Conference, 21-25 September 2008, Adelaide, Australia* pp 5876 ref. 9

Miller, P. R., McConkey, B. G., Clayton, G. W., Brandt, S. A., Staricka, J. A., Johnston, A. M., ... & Neill, K. E. (2002). Pulse crop adaptation in the northern Great Plains. *Agronomy journal*, **94**(2), 261.

Roy, S.K., Rahman, F.H., Pal, P.P., Basak,J. (2016-17). Enhancing Pulse Productivity through Agro-Technologies under Clustered Frontline Demonstration Programme. ICAR-Agricultural Technology Application Research Institute. pp, 5.

Tesdale, L.R. and Frank, J.R. (1983). Effect of row spacing on weed competition with snapbean. *Weed Science*, **31**, 81-S.

Thangwana, N.M. and Ogola, J.B.O. (2012). Yield and yield components of Chickpea (*Cicer arietinum* L), Response to genotype and planting density in summer and winter sowing. *Journal of Food, Agriculture and Environment.* **10** (2), 710-715

Whish, J.P.M., Sindel, B.M., Jessop, R.S., Felton, W.L. (2002). The effect of row spacing and weed density on yield loss of chickpea. *Australian Journal of Agricultural Research*. **53**, 1335-1340

Zimdahl, R.L. 1980. Weed crop competition-A review. International Plant Protection Centre, Corvallis, OR, USA.