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Production of newly released soybean varieties as influence by plant geometry and raised bed condition

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Abstract
The present investigation entitled "Production of newly released soybean varieties as influence by plant geometry and raised bed condition" was carried out at Instructional Farm, DKS CARS Bhatapara during *Kharif* season of 2019. Experiment was laid out in Split Plot Design (SPD) with three replications. The trial was conducted in a split plot design with plant geometry as main plot and varieties in sub plot. The experiment comprised four different plant geometry *viz.* 30×10, 30×15, 45×10 and 45×15 cm row to row and plant to plant spacing and four different varieties *viz.* CG Soya 1, RSC 1052, RSC 1046 and RSC 1071 was planted in raised bed system. Optimum plant population is pre requisite obtain higher seed production and productivity of soybean. The result revealed that plant geometry 30×10 cm was to produce to significant higher growth parameters, yield attributing characters as compared to all other plant geometry. Variety RSC 1046 was recorded significant higher growth parameters, yield attributing characters and yield as compared to all other varieties.

Keywords: Plant geometry, variety growth, yield attributes, and yield

Introduction
Soybean (*Glycine max* L. Merrill) is known as the "Wonder Crop and Golden Bean'' of the 21st century. It is one of the oilseed crop second ranked among important oilseed crops of India. It is the only crop to be included in both the oilseed and the pulses categories. It is the most accessible, richest and easiest source of best quality protein. Due to the various applications of food and industrial products. It is an excellent health food containing soybean seed approximately 20% oil, 40% protein, 30% carbohydrates, 10% total sugar and 5% ash. (Iıta, 1992; Iıta, 1993) [10, 11] and its seed oil is rich in essential fatty acids (Acikgoz *et al*., 2009) [1]. This very useful crop is grown in many countries but land coverage in the United States of America is largest. India is the world's third largest edible oil economy after the USA and China. In India, its cultivation in 2000 covers an area of 12.2 million hectares with production was 89.19 lakh tones in 2015 -16 and an average productivity of 922 kg ha-1 2017-18 (Anonymous, 2018) [2]. In India the soybean production is comparatively lower than the world average (2484 kg ha-1). In India the major soybean producing states are Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh and Karnataka. In Chhattisgarh, soybean grown during the *Kharif* season occupies 159.59 thousand ha with an average yield of 975 kg ha-1 (Anonymous, 2018) [2]. Main soybean growing districts of Chhattisgarh are Bemetara, Dhamtari, Rajnandgaon, Durg, Mahasamund and Kabirdham.
The soybean optimum plant population and plant geometry are the important factors for achieving higher soybean grain yields. The higher plant population creates plant to plant competition for water, light, nutrients and space resulting reduce the plant growth and poor yield. On the other hand, lower plant population is unable to exploit the available resources and these resources go wastes. Higher plant populations have led to increased plant height due to plant to plant competition for light. (Rajput and Shrivastava 1999) [16].

Materials and Method
A field experiment was conducted at Instructional Farm, DKS CARS Bhatapara, during rainy season of 2019. The experiment was laid out in split plot design with three replication. The treatments was consisted of four varieties CG Soya 1, RSC 1052, RSC 1071 and RSC 1046, and four plant geometry(cm) 30× 10, 30×15, 45×10, and 45×15. Plant geometry in main plant and varieties in sub plot are adopted. Crop was sown in first week of July. Recommand dose of fertilizer applied 25 kg ha-1 of nitrogen, 60 kg ha-1 phosphorus and 40 kg ha-1 potassium. Crop planting was eight July and harvest in last week of October.

Five plants were taken for recording growth parameters. The seed yield was taken plot wise and converted into kg ha-1. Optimum plant population and plant geometry are important factor for obtaining high seed yields of soybean.

Results and Discussion

Effect of plant geometry and varieties in growth parameters of soybean. The data was showed in Table 1. The result revealed that plant geometry 30×10 was recorded significant maximum tallest plant, maximum number of branches plant-1, number of leaves plant-1, Leaf area plant-1 and dry matter accumulation plant-1 as compared to other plant geometry. Growth parameters like plant height and number of branches plant-1 was recorded at par with in case of plant geometry under 30×10. Data was recorded with growth parameter variety RSC 1046 was recorded significant maximum tallest plant, maximum number of branches plant-1, number of leaves plant-1, Leaf area plant-1 and dry matter accumulation plant-1 as compared to other varieties.

Table 1: Growth parameter of soybean as influenced by plant geometry of newly released soybean varieties planted on raised bed system

Treatment	Plant height	Number of branches	No of leaves	Leaf Area	Dry matter accumulation
		plant-1	plant-1	plant-1	plant-1
Plant Geometry (R×P)					
P1 - 30×10	69.89	6.94	49.44	809.5	34.48
P2 - 30×15	63.86	6.56	46	729.9	32.44
P3 - 45×10	68.25	6.88	47.04	770.4	32.7
P4 - 45×15	59.12	6.24	43.36	676.6	31.02
S.Em±	0.99	0.1	0.69	2.14	0.63
CD (P=0.05)	3.45	0.3	0.84	8.31	1.4
Varieties					
V1 - CG Soya 1	66.59	6.79	48.36	774.7	33.2
V2 - RSC 1052	62.55	6.03	36.74	681.2	31.23
V3 - RSC 1046	68.97	7.4	55.91	807.5	33.53
V4- RSC 1071	63.02	6.4	44.83	723	32.67
S.Em±	0.22	0.11	0.95	4.57	0.89
CD (P=0.05)	1.7	0.32	2.02	14.34	1.63

Growth parameters like plant height and number of branches plant-1 was recorded at par with in case of Varierty in CG Soya 1. Significant highest growth parameters show sequence to high to low in case of plant geometry under 30×10, 45×10, 30×15 and 45×15. Data shows significant highest growth parameters in case of varieties high to minimum, highest in variety RSC 1046, CG Soya 1, RSC 1071 and minimum in RSC 1052. The increase in plant height at closer spacing might have been caused due to increased plant population density. The higher population density caused mutual shading in plants that contributed to stem elongation and ultimately plant height increased. Similar results were also reported by Pendersen and Lauer (2003) [14]. Narrow spacing planting of crop increasing plant densities, increase of plant density, decreased the number of branches plant-1 due to plants at higher densities accumulate less carbon which is not sufficient to support more branching. Similar results have been reported by Reddy *et al.* (1999) [18]. Ibrahim (1996) [9] also reported that leaf area increased with increasing plant density its direct related to close plant spacing. Higher dry matter accumulation was directly related to the higher value of

LAI and leaf area at different crop growth stage which gives an indication of higher photosynthesis and better plant growth rate. Effect of plant geometry and varieties in yield attributes of soybean**.** Data pertaining to number of pod plant-1 presented in Table 2. The data revealed that significantly higher pods plant-1 was recorded under plant geometry of 30×10 and lowest in 45×15. Varieties was recorded significant higher number of pods plant-1 in RSC 1046 and lowest in RSC 1052. Plant population increased number of pods plant-1 possibly due to more competition amongst plants for nutrients, moisture, sunlight and space. Though the number of pods plant-1 decreased with increase in plant population yet the number of pods per unit land area increased thus resulting in higher grain yield at higher plant population level (Kang *et al.*, 1998) [12]. Narrow row and plant spacing ensured early canopy coverage and maximum light interception, crop growth rate and crop biomass, resulting in increased number of pod and yield potential per unit area. Similar results have been reported by Boydak *et al.* (2004) [7] and Malek *et al.* (2012) [13].

The data on number of seeds pod-1 are presented in Table 2. The data revealed that significantly maximum number of seed pod-1 was recorded under plant geometry 30×10 and lowest in 45×15. Varieties was recorded significant higher number of seed pod-1 in RSC 1046 was and lowest in RSC 1052. Data on test weight are presented in Table 2. The findings revealed that test weight (g) has no significant difference due to plant geometry and varieties.

Table 2: Yield attributes of soybean as influenced by plant geometry of newly released soybean varieties planted on raised bed system

Treatments	No. of pods plant-1	No. of seed pod-1	Test weight (g)
Plant Geometry (R×P)			
P1 - 30×10	68.34	3.43	12.15
P2 - 30×15	59.36	2.88	12.10
P3 - 45×10	62.20	3.12	12.06
P4 - 45×15	56.28	2.62	11.96
S.Em±	0.66	0.04	0.09
CD (P=0.05)	2.29	0.15	NS
Varieties			
V1 - CG Soya 1	61.36	3.15	12. 17
V2 - RSC 1052	58.58	2.53	11.88
V3 - RSC 1046	67.31	3.32	12.20
V4- RSC 1071	58.94	3.06	12.14
S.Em±	0.45	0.08	0.13
CD (P=0.05)	1.32	0.23	NS

Effect of plant geometry and varieties in yield of soybean The data pertaining to seed yield has been presented in Table 3. The data revealved that there was significant difference recorded in seed yield due to plant geometry and varieties planted on raised bed system. Significantly maximum seed yield was recorded under plant geometry 30×10 and minimum under 45×15. Significant higher seed yield recorded in variety RSC 1046 and minimum in RSC 1052. Verma (2019) [19] recoded that significant higher growth parameter like plant height, number of branches plant-1, leaf area, leaf area index and dry matter accumulation plant-1 in variety in RSC 1046 with crop geometry 45×10. Due to increased seed yield was observed in variety RSC 1046 and spacing 45×10.

The highest seed yield in the lowest spacing could have been achieved by early canopy closure in the narrowest rows that facilitated high total dry matter production. The leaf area development with closer spacing contributed to high total dry matter production due to higher solar radiation interception that contributed to higher yield production (Ball *et al.* 2000) [4]. The narrow row soybean gives higher yield than the wider row soybean because of greater light interception. Similar results have been reported by Board *et al.* (1992) [6], Aslam *et al.* (1993) [3].

The data pertaining to seed yield has been presented in Table 3.1. Data on stover yield as affected by plant geometry and varietiea. Stover yield, was observed significantly highest under plant geometry 30×10 and minimum stover yield under 45×15. Variety was recorded significant higher stover yield in RSC 1046 and minimum in RSC 1052. The more biomass produced at narrow plant spacing was due to more plant population contributing to the final biomass production. Similar results have been reported by Rasul *et al*. (2012) [17].

The data on harvest index for different plant geometry and varieties have been presented in Table 3. The result indicated that significantly maximum harvest index was computed under plant geometry 30×10 and lowest under 45×15. Variety was computed significant highest harvest index in RSC 1046 and minimum in RSC 1052. Harvest index of soybean increased with increasing plant population. Reported by Ball *et al*. (2000) [4], Edwards and Purcell (2005) [8] and Malek *et al*. (2012) [13]. High harvest index reported as compared to over the flat bed condition. (Basediya *et al*, 2018) [5].

Table 3: Seed yield, stover yield and harvest index of soybean as influenced by plant geometry of newly released soybean varieties planted on raised bed system

Treatment	Seed yield (kg ha-1)	Stover yield (kg ha-1)	Harvest index
Plant Geometry (R×P)			
P1 - 30×10	2746	3842	41.45
P2 - 30×15	2340	3385	40.66
P3 - 45×10	2494	3578	40.92
P4 - 45×15	1709	2539	39.81
S.Em±	43.49	56.54	0.18
CD (P=0.05)	150.52	195.68	0.28
Varieties			
V1 - CG Soya 1	2679	3812	41.20
V2 - RSC 1052	1484	2272	39.29
V3 - RSC 1046	3091	4286	41.84
V4- RSC 1071	2034	2974	40.5
S.Em±	48.7	63.31	0.24
CD (P=0.05)	142.16	184.81	0.41

Conclusion

There research programme was recorded plant geometry under 30×10 best performance as compared to other plant geometry in terms of growth parameters, yield attributes and yield of soybean. Variety was performance recorded in RSC 1046 higher in terms of growth parameters, yield attributes and yield of soybean. All above facts plant geometry 30×10 and variety RSC 1046 performance is best in soybean planted in raised bed system

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