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Research Article

Variation in Reproductive Efficiency of Groundnut (*Arachis hypogea* L.) Genotypes at Different Planting Densities

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ABSTRACT

A field experiment was conducted during kharif season, 2018 and 2019 at S.V. Agricultural college, Tirupati to study the 'Variation in reproductive efficiency of groundnut (Arachis hypogea L.) genotypes at different planting densities'. Instant increase in groundnut yields can be achived by reorienting its planting geometry. However identification of right variety with right plant architechture which fits into closed spacings is reduced. The experiment was laid out in split plot design with twelve treatments and three groundnut varities Kadiri 6, Kadiri 9 and Dharani with four spacings (S_1: 30X10 cm, S_2: 30X5 cm, S_3: 20X10 cm and S_4: 20X5 cm). Among the Spacings 20X10 cm (50 plants m^{-2}) recorded significantly higher (3,616.87 kg ha^{-1}) followed by 20x5cm (3,157.07 kg ha^{-1}) and significantly lower pod yields in 30x10 cm (2,904.87 kg ha^{-1}) and recommended spacing 30X5cm (2,540.07 kg ha^{-1}). Among the three varieties Decumbent-3, Dharani recorded highest pod yield (3403.48 kg ha^{-1}) followed by Decumbent-2 type, kadiri-9 (3292.65 kg ha^{-1}) and least by Erect type, Kadiri-6 (2467.94 kg ha^{-1}). However genotype performance was varied with the spacings adopted Kadiri-6 performed better under recommended spacing only (30x10 cm). Kadiri-9 variety also showed decreased yields when plant to plant to plant spacing was reduced. However Dharani recorded higher flower to peg ratio, peg to pod ratio and yields even in plant to plant and row to row spacings were reduced. Hence, to increase the groundnut productivity Dharani can be recommended at a spacing of 20x10 cm (50 plants m^{-2}).

Keywords: *Spacings, Row to row, Flower to peg ratio, Peg to pod ratio, Yield.*

INTRODUCTION

Yield potential of any crop plant mainly depends on growth, reproductive efficiency and partitioning efficiency. Groundnut an inderminate leguminous crop has varied flowering behaviour. Less than 10 per cent of the flowers produced develop into mature pods (Othman 1979; & Lim et al., 1980). The reproductive efficiency of groundnut has significant effect on yield of groundnut.

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Reproductive efficiency of groundnut depends on collecting light, assimilating carbon, production of viable flowers, pegs, flower to peg ratio, conversion of and pegs to filled pods (peg to pod ratio). However, Groundnut architecture plays a key role in collecting light and assimilating carbon and thus affects plant growth and yield. Groundnut has been commonly classified in to six groups (Reddy, 1988). They are Procumbent 1, Procumbent 2, Decumbent 1, Decumbent 2, Decumbent 3 and erect type. These types are classified based on type of main axis and nature of lateral branches.

Even though genetic and agronomic practices aim at selecting optimal combinations of traits to increase yield potential of groundnut. Instant increase in groundnut yields can be achived by reorienting its planting geometry. Increasing plant densities result in increased plant height, more number of aerial pegs and more number of unfilled pods which ultimately effects the reproductive efficiency of groundnut. However identification of right variety with right plant architechture and good reproductive efficiency which fits into closed spacings is the main concern of this work.

MATERIALS AND METHODS

The present investigation was carried out at dryland farm, S.V. Agricultural College, Tirupati (13.6288° N, 79.4192° E) during *kharif*, 2018 and *kharif*, 2019. The experiment was laid out in split plot design with twelve treatments and three replications. Three Spanish bunch groundnut genotypes with variable growth habits viz., erect type (Kadiri-6), decumbent-2 (Kadiri-9) and Decumbent-3 (Dharani) were sown at four plant densities viz., 20X5cm (100 plants m^{-2}), 30X5 cm (66.6 plants m^{-2}), 20X10cm (50 plants m^{-2}), and recommended spacing of 30 X10 cm (33.3 plants m^{-2}). The data on number of flowers, number of pegs, flower to peg ratio, number of filled and unfilled pods, peg to pod ratio and yield were recorded.

Three plants were collected randomly and measured the plant height from base of the plant to shoot tip and expressed in centimeters (cm) at harvest.

Five randomly tagged plants were separately and the total number of flowers per plant were counted daily and mean of five plants was computed.

Five randomly tagged plants were harvested separately and the total number of pegs per plant, number of primary branches, number of filled pods and unfilled pods per plant were counted and mean of five plants was computed.

Flower to peg Ratio was calculated by using below formula. (Bhagavatha et al., 2017).

$$\text{Flower to peg ratio} = \frac{\text{Number of pegs per plant}}{\text{Number of flowers per plant}} \text{ X100}$$

$$\text{Peg to Pod ratio} = \frac{\text{Number of pods per}}{\text{Number of pegs per plant}} \text{ X 100}$$

RESULTS AND DISCUSSION

Plant Height (cm)

Pooled data of two seasons revealed that among the three genotypes, erect type, Kadiri-6 recorded highest plant height (46.35 cm) at harvest followed by decumbent-3 type Dharani (44.11 cm) and least by decumbent-2 type Kadiri-9 (36.70 cm). Kadiri-6 was significantly higher than Dharani and Kadiri-9. Highest planting density of 100 plants m^{-2} (20X5 cm) recorded significantly higher plant height (52.59 cm) in Kadiri-6 and plant height at recommended spacing (30X10 cm) was significantly lowest in Kadiri-9 (30.17 cm). Plant height is the phenotypic responses for light to reduce deleterious effects of stressful

environments. Similar results were reported by Ackerely et al. (2000).

Number of primary branches

Pooled data of two seasons revealed that among the three genotypes, Dharani (decumbent-3) recorded significantly higher number of primary branches (4.75) followed by decumbent-2 type, Kadiri-9 (4.00) and least by erect type, Kadiri-6 (4.00). Among the Spacings, number of primary branches was maximum at recommended spacing, 30X10 cm (33.3 plants m^{-2}). 30X10 cm (33.3 plants m^{-2}) recorded significantly higher number of primary branches (4.89) followed by 20x10 cm (4.11), 30x5 cm (4.00) and lower number of primary branches was observed in 20X5 cm (4.00). Number of primary branches in all the genotypes decreased with increase in spacing per hectare. Plant height was significantly higher in 20x5 cm in all genotypes. There by number of primary branches were reduced. Similar results were reported by Howlader et al. (2009)

Number of Flowers

Pooled data of two seasons revealed that among the three genotypes, Kadiri-9 (decumbent-2) recorded significantly higher number of flowers (102.41) followed by decumbent-3 type, Dharani (87.32) and erect type, Kadiri-6 (76.88). Kadiri-9 recorded more flowers because flower production was observed even after 75 DAS compared to Dharani and Kadiri-6. Decumbent types (Kadiri-9 and Dharani) has initiated early branching resulting in increase total flower bearing areas per plant and longer duration of flowering than erect type (Kadiri-6).

Number of flowers was maximum at recommended spacing 30X10 cm (33.3 plants m^{-2}). 30X10 cm (33.3 plants m^{-2}) recorded significantly higher number of flowers (108.36) than 20x10 cm (91.49), 30X5 cm (81.51) and lowest number of flowers was observed in 20 X5 cm (74.10).

Table 1: Physiological traits of groundnut genotypes as effected by planting densities

	Plant Height (Cm)			Number of primary branches			Number of flowers		
	2018	**2019**	**POOLED**	**2018**	**2019**	**POOLED**	**2018**	**2019**	**POOLED**
Varieties (V)									
V1:k6 (Erect)	44.19	48.51	**46.35**	4.00	4.00	**4.00**	80.40	73.35	**76.88**
V2:k9 (Decumbent-2)	36.03	37.36	**36.70**	4.00	4.00	**4.00**	105.05	99.77	**102.41**
V3: Dharani (Decumbent-3)	43.12	45.10	**44.11**	4.83	4.67	**4.75**	88.24	86.39	**87.32**
SE (m)	0.65	0.52	**0.37**	0.11	0.05	**0.07**	1.19	0.86	**0.85**
C.D (P=0.05)	1.95	1.58	**1.33**	0.32	0.15	**0.21**	3.59	2.61	**2.99**
Spacing (S)									
S1: 30X10 cm (33.3 plants/m2)	36.511	36.84	**36.68**	4.89	4.89	**4.89**	107.06	109.67	**108.36**
S2: 30X 5 cm (66.6 plants /m2)	41.440	45.81	**43.63**	4.00	4.00	**4.00**	84.70	78.33	**81.51**
S3: 20x10 cm (50 plants /m2)	39.978	43.25	**41.62**	4.22	4.00	**4.11**	95.10	87.89	**91.49**
S4:20x5 cm (100 plants/m2)	46.536	48.72	**47.63**	4.00	4.00	**4.00**	78.07	70.13	**74.10**
SE(m)	0.44	0.67	**0.34**	0.14	0.06	**0.07**	0.86	1.43	**0.82**
C.D (P=0.05)	1.54	2.36	**1.21**	0.49	0.19	**0.21**	3.03	5.05	**2.47**

Number of Pegs per plant

Kadiri-9 (decumbent-2) recorded highest number of pegs (58.80) followed by decumbent-3 type, Dharani (51.16) and least by erect type, Kadiri-6 (37.09). Kadiri-9 was significantly higher than Dharani and Kadiri-6.

Number of pegs per plant was maximum at recommended spacing 30X10 cm (33.3 plants m^{-2}). Significant variability was observed among the all spacings. 30X10 cm (33.3 plants m^{-2}) recorded significantly higher number of pegs (64.69) than 20x10 cm (51.37), 30X5 cm

(42.12) and lowest number of pegs was observed in 20X5 cm (36.34). Decumbent genotypes and recommended plant spacing has more number of pegs, might be due to higher number of primary and secondary branches there by can partition appropriate amount of photosynthate to pegs along with their viability and number (Luz et al., 2011).

Table 2: Reproductive traits of groundnut genotypes as influenced by planting densities

	Number of pegs per plant			Number of filled pods per plant			Number of unfilled pods per plant		
	2018	**2019**	**POOLED**	**2018**	**2019**	**POOLED**	**2018**	**2019**	**POOLED**
Varieties (V)									
V1:k6 (Erect)	31.89	40.98	**37.09**	13.84	15.88	**14.86**	2.49	4.99	**3.74**
V2:k9 (Decumbent-2)	62.29	55.31	**58.80**	22.62	20.89	**21.76**	11.39	10.92	**11.16**
V3: Dharani (Decumbent-3)	50.26	52.06	**51.16**	22.11	23.98	**23.05**	7.37	10.79	**9.08**
SE (m)	0.87	0.75	**0.65**	0.43	0.45	**0.15**	0.10	0.25	**0.15**
C.D (P=0.05)	2.63	2.27	**1.96**	1.31	1.36	**0.45**	0.30	0.75	**0.44**
Spacing (S)									
S1: 30X10 cm (33.3 plants/m2)	60.77	68.61	**64.69**	30.75	32.69	**31.73**	9.43	12.56	**10.99**
S2: 30X 5 cm (66.6 plants /m2)	45.19	42.12	**43.66**	16.34	16.41	**16.38**	6.54	7.43	**6.98**
S3: 20x10 cm (50 plants /m2)	50.91	51.82	**51.37**	19.61	19.76	**19.69**	8.09	10.42	**9.25**
S4:20x5 cm (100 plants/m2)	37.44	35.25	**36.34**	11.39	12.14	**11.78**	4.29	5.19	**4.74**
SE(m)	0.85	0.77	**0.56**	0.38	0.49	**0.11**	0.13	0.14	**0.11**
C.D (P=0.05)	2.99	2.70	**1.96**	1.33	1.74	**0.40**	0.45	0.50	**0.40**

Flower to peg ratio

Kadiri-9 (decumbent-2) recorded highest flower to peg ratio (58.09) followed by decumbent-3 type, Dharani (57.16) and least by erect type, Kadiri-6 (47.51). Flower to peg ratio was maximum at recommended spacing 30X10 cm (33.3 plants m^{-2}). 30X10 cm (33.3 plants m^{-2}) recorded significantly higher flower to peg ratio (59.61) than 20x10 cm (56.18), 30X5 cm (52.69) and lowest flower to peg ratio was observed in 20X5 cm (48.54). Reproductive efficiency has positive correlation with number of pegs at lower plant third and negative correlation with plant height. In upright cultivars which can reach a length more than 60cm under suitable environmental conditions, which is energetically costly for the plant (Santos et al., 2000).

Number of Filled Pods Plant^{-1}

Among the three genotypes, Dharani (decumbent-3) recorded significantly higher number of filled pods (23.05) followed by decumbent-2 type, Kadiri-9 (21.76) and least by erect type, Kadiri-6 (14.86). Less than 10 per cent of the flowers produced, develop into mature pods (Othman 1979 & Lim et al., 1980). Decumbent genotypes (Kadiri-9 and Dharani) with wider branch angle and less plant height are able to reach the soil and convert pegs into pods compared to erect (Kadiri-6) which has increased plant height. However, more aerial pegs were observed in Kadiri-9 compared to Kadiri-6 Similar results were reported by Sreelatha et al. (2019).

Number of filled pods per plant was maximum at recommended spacing 30X10 cm (33.3 plants m^{-2}). Significant variability in number of filled pods was observed among all spacings. 30X10 cm (33.3 plants m^{-2}) recorded significantly higher number of filled pods (31.73) than 20x10 cm (19.69), 30X5 cm (16.38) and lowest number of filled pods was observed in 20X5 cm (11.78).

Number of Unfilled Pods Plant^{-1}

Kadiri-9 (decumbent-2) recorded significantly higher number of unfilled pods (11.16) followed by decumbent-3 type, Dharani (9.08) and least by erect type, Kadiri-6 (3.74). Similar to filled pods, number of unfilled pods per plant also recorded higher at recommended spacing 30X10 cm (33.3 plants m^{-2}). 30X10

cm (33.3 plants m^{-2}) recorded significantly higher number of unfilled pods (10.99) than 20x10 cm (9.25), 30X5 cm (6.98) and lowest number of unfilled pods was observed in 20 X5 cm (4.74).

Peg to pod ratio

Peg to pod ratio denotes the reproductive efficiency among the groundnut genotypes. Among the three genotypes, Dharani (decumbent-3) recorded significantly higher peg to pod ratio (61.76) followed by decumbent-2 type, Kadiri-9 (54.49) and erect type, Kadiri-6 (48.42). Dharani which is decumbent -3 with wider branch angle the number of aerial pegs were low in number compared to Kadiri-9 and Kadiri-6. Aerial peg number increased as results of higher population due to increased plant height and hence, pegs fail to penetrate into the soil.

Peg to pod ratio was maximum at recommended spacing 30X10 cm (33.3 plants m^{-2}). Significant variability in peg to pod ratio was observed among the all spacings. 30X10 cm (33.3 plants m2) recorded significantly higher peg to pod ratio (65.34) than 20x10 cm (56.10), 30x5 cm (53.06) and lowest peg to pod ratio was observed in 20 X5 cm (45.07).

Pod Yield (Kg ha^{-1})

Decumbent growth habit genotypes Dharani (Decumbent-3), Kadiri-9 (Decumbent-2) recorded higher pod yields of 3403.48 kg ha^{-1} and 3292.65 kg ha^{-1} respectively compared to erect type, Kadiri-6 (2467.94 kg ha^{-1}). Dharani, decumbent-3 growth habit had more yield because of high flower number, number of pegs, flower to peg ratio and peg to pod number. Similar results were reported by Haro et al. (2013) and Sreelatha et al. (2019).

Significant variability in pod yield was observed among the all spacings. Among the Spacings, pod yield was maximum at 20X10 cm (50 plants m^{-2}). 20X10 cm (50 plants m^2) recorded significantly higher (3,616.87 kg ha^{-1}) followed by 20x5cm (3,157.07 kg ha^{-1}), 30x5 cm (2,540.07 kg ha^{-1}) were as 30X10 cm recorded significantly lowest pod yield (2,904.87 kg ha^{-1}). The data on interaction between genotypes and spacings revealed significantly higher pod yield when Dharani was sown at a spacing of 20X10 cm (4,090.01 kg ha^{-1}) whereas lowest pod yield was observed in Kadiri-6 sown at a spacing of 30 X5 cm (2,109.59 kg ha^{-1}).

Table 3: Reproductive traits of groundnut genotypes as influenced by planting densities

	Flower to peg ratio			Peg to pod ratio			Pod yield (Kg ha^{-1})		
	2018	2019	POOLED	2018	2019	POOLED	2018	2019	POOLED
Varieties (V)									
V1:k6 (Erect)	40.23	54.69	**47.51**	47.81	49.04	**48.42**	2669.02	2266.86	**2467.94**
V2:k9 (Decumbent-2)	59.23	55.09	**57.16**	53.23	55.75	**54.49**	3714.61	2870.69	**3292.65**
V3: Dharani (Decumbent-3)	56.57	59.63	**58.09**	57.25	66.17	**61.71**	3699.38	3107.56	**3403.48**
SE (m)	1.28	1.40	**1.02**	1.32	1.43	**1.10**	114.39	42.28	**62.12**
C.D (P=0.05)	3.88	4.24	**3.09**	4.04	4.34	**3.34**	345.88	127.84	**187.83**
Spacing (S)									
S1: 30X10 cm (33.3 plants/m2)	56.18	63.04	**59.61**	65.16	65.51	**65.34**	3,095.32	2,714.42	**2,904.87**
S2: 30X 5 cm (66.6 plants /m2)	51.89	53.50	**52.69**	50.42	55.71	**53.06**	2,758.70	2,321.44	**2,540.07**
S3: 20x10 cm (50 plants /m2)	53.05	59.30	**56.18**	54.18	58.01	**56.10**	3,882.45	3,351.28	**3,616.87**
S4:20x5 cm (100 plants/m2)	47.03	50.04	**48.54**	41.42	48.72	**45.07**	3,707.79	2,606.35	**3,157.07**
SE(m)	0.85	0.95	**0.45**	1.7	1.74	**0.99**	143.39	36.49	**77.94**
C.D (P=0.05)	3.01	3.37	**1.59**	4.12	6.17	**3.05**	345.89	128.74	**274.98**

CONCLUSION

Reproductive efficiency of Decumbent genotypes (Dharani and Kadiri-9) is better under varied plant densities compared to erect type (Kadiri-6). Number of flowers, number of pegs, flower to peg and peg to pod ratio are

higher at recommended plant density (30X 10 cm) and in decumbent types (Dharani and Kadiri-9). Decumbent-3 type growth habit genotype Dharani resulted in significantly high pod yield (3403.48 kg ha^{-1}) and recommended spacing of 20X10 cm (3616.87 Kg ha^{-1}) whereas lowest pod yield was observed in kadiri-6 (2467.94 kg ha^{-1}) and at 30X5 cm (2540.07 kg ha^{-1}).

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