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P Sujathamma
Programme Coordinator, DAATTC, Kurnool, Andhra Pradesh, India

B Santhosh Kumar Naik
Agricultural Research Station, Podalakur, SPS Nellore, Andhra Pradesh, India

Corresponding Author:
P Sujathamma
Programme Coordinator, DAATTC, Kurnool, Andhra Pradesh, India

Response of groundnut varieties to different seed rates

P Sujathamma and B Santhosh Kumar Naik

Abstract
Background: The performance of groundnut varieties is varied with the season, seed rate and soil type. Optimum seed rate for a given variety at specific situation not only reduce the cost of cultivation, but also augment the full yield potential of the variety. Growing of groundnut during *rabi* season gaining momentum in southern agro climatic zone of Andhra Pradesh. Due to lack of suitable variety and optimum seed rate for *rabi*, the farmers are using higher seed rate even though it is a costly input in groundnut cultivation.
Methods: A field experiment was conducted at Agricultural Research Station, Podalakur during Rabi 2018-19 to study the response of groundnut varieties to different seed rates. The experiment was conducted in split plot design with varieties (V_1: Dharani; V_2: Kadiri Amaravathi; V_3: Kadiri Harithandra; V_4: Kadiri-9; V_5: Kadiri-6) in main plot and seed rates **(**S_1: 180 kg ha^{-1} (30cm x 10cm); S_2: 225 kg ha^{-1} (30cm x 7.5 cm); S_3: 270 kg ha^{-1} (30cm x 5.0cm); S_4: 315 kg ha^{-1} (30cm x 2.5cm) in subplot and replicated the treatments thrice.
Conclusion: Among the different varieties, Kadiri Harithandra resulted in the highest dry pod yield (2309 kg ha^{-1}), while the lowest pod yield was recorded with K-6 (1126 kg ha^{-1}). The highest pod yield (2270 kg ha^{-1}) was registered with seed rate of 270 kg ha^{-1}, while the lowest pod yield of 1938 kg ha^{-1} was recorded with seed rate of 315 kg ha^{-1}.

Keywords: Groundnut, varieties, seed rates, pod yield

Introduction
Groundnut (*Arachis hypogaea* L.) is an important oilseed crop in India which occupies first in terms of area and second position in terms of production. China is the largest producer as well as consumer of groundnut in the world with 166.24 lakh tonnes followed by India (68.57 lakh tonnes), Nigeria (30.28 lakh tonnes) and United States (25.78 lakh tonnes). In India, Andhra Pradesh ranks second both in area (7.48 lakh tonnes) and production (4.62 lakh tonnes) with an average productivity of 618 kg ha^{-1}. Growing of groundnut during *rabi* season gaining momentum in southern agro climatic zone of Andhra Pradesh. Due to lack of suitable variety and optimum seed rate for *rabi*, the farmers are using higher seed rate even though it is a costly input in groundnut cultivation. The performance of groundnut varieties is varied with the season, seed rate and soil type. Optimum seed rate for a given variety at specific situation not only reduce the cost of cultivation, but also augment the full yield potential of the variety. Hence an investigation was carried out to identify suitable variety and seed rate for *rabi* season under southern agro climatic zone of Andhra Pradesh.

Material and Methods
The experiment was conducted during *rabi*, 2018-19 at Agricultural Research Station, Podalakur ($14^0$22'N latitude, $79^0$44'E longitude and 43m above mean sea-level), SPS Nellore district, Andhra Pradesh. The climatic condition of Sothern agro climatic zone is sub-tropical influenced by north-east monsoon. The soils are clay loam in texture, porous and grayish black having pH of 8.48, EC of 0.229 dSm^{-1}, organic carbon 0.3%, available nitrogen 201 kg ha^{-1}, available phosphorus 46 kg ha^{-1} and available potassium 225 kg ha^{-1}. The field experiment was laid out in a split plot design with 5 varieties of groundnut (V_1: Dharani; V_2: Kadiri Amaravathi; V_3: Kadiri Harithandra; V_4: Kadiri-9; V_5: Kadiri-6) in main plot and 4 seed rates (S_1: 180 kg ha^{-1} (30cm x 10cm); S_2: 225 kg ha^{-1}(30cm x 7.5 cm); S_3: 270 kg ha^{-1}(30cm x 5.0cm); S_4: 315 kg ha^{-1}(30cm x 2.5cm) in subplot and replicated the treatments thrice. Sowings were done on 28- 11-2018 in lines at 30 cm with the help of Tyne by opening a shallow furrow at uniform depth of 5cm. The recommended dose of fertilizer @ 20 kg N, 40 kg P_2O_5 and 50 kg K_2O per hectare were applied as basal and 10 kg N ha^{-1} was applied as top dressing at 30 DAS and gypsum @ 500 kg ha^{-1} was applied at 40DAS.

Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. The water requirement of groundnut is around 400 mm. The total rainfall of 290.3 mm was received in 10 rainy days during the crop growing period. Four supplemental irrigations were given. Number of pods per plant and pod yield per hectare were recorded by following the procedure described by Kolan *et al*. (2013) [8].

Results and Discussion

Plant height: Plant height was significantly influenced by the varieties, but seed rates and interaction of varieties and seed rates did not have significant influence on the plant height. Among the five varieties tested K-6 recorded significantly taller plants (32.46 cm). The results are in conformity with the findings of Soumya *et al*. (2011) [13] and Priya *et al*. (2016) [4].

Pods per plant: Significant difference was observed for number of pods per plant by the varieties. Among different varieties, the highest number of pods per plant (18) was recorded with K-9, while the lowest number of pods per plant was recorded with Kadiri Harithandra. The variation in the number of pods per plant observed was highly attributed to the genetic character of the groundnut varieties. Similar results were reported by Ahmad *et al*. 2007 [2], Konlan *et al*. 2013 [8], Gabisa *et al*. 2017 [5] and Yousif and Hussain, 2019. Among the different seed rates, significant variation was observed in number of pods per plant. The highest number of pods per plant (15) was recorded at 180 kg ha^{-1}, while the lowest number of pods per plant was recorded at 315 kg ha^{-1}. Virk *et al*. (2005) [14] and Abdullah *et al*. (2007) [1] also reported that increased seeding rate (plant density) decreased number of pods per plant and as seed rate decreased number of pods per plant increased. These results are in agreement with the findings of Awal and Aktar (2015) [3], Gabisa *et al*. (2017) [5], Onat *et al*. (2017) [11], Kurt *et al*. (2017) [9], Yousif and Hussain (2019) [15] and Magagula *et al*. (2019) [10]. The interaction between varieties and seed rates was not significantly influenced the number of pods per plant.

100 dry pod weight: Among the five varieties, Kadiri Harithandra resulted in significantly the highest 100 dry pod weight, but which was on par with Kadiri Amaravathi. Among the four seed rates, seed rate of 180kg ha^{-1} produced significantly the highest 100 dry pod weight and which was at par with 225 kg ha^{-1}. The 100 dry pod weight was negatively correlated with plant density. The highest 100 dry pod weight was found in the lower plant density, due to less competition among the plants to get enough space for their growth and development. Onat *et al*. (2017) [11] and Kurt *et al*. (2017) [9] indicated that as the number of plants per unit area increased, competition for growth resources such as nutrient, water and light also increased. The interaction between varieties and seed rates failed to influence the 100 dry pod weight.

Shelling percentage: Shelling percentage is the indication of pod filling efficiency and high shelling percentage values indicate effective pod filling. Shelling percentage was significantly influenced by varieties and seed rates (Table 1). Significantly the highest shelling percentage (80.5%) was recorded with K-9 variety. The reason is that the difference between the varieties for the shelling percent originated from their genetic background. Similar results were reported by Rakesh *et al*. (2010) [12], Konlan *et al*. (2013) [8] and Hatil *et al*. (2020) [7]. The different seed rates have significantly influenced the shelling percentage, 225 kg ha^{-1} recorded the highest shelling percentage, but which was on par with seed rates of 180 kg ha^{-1} and 270 kg ha^{-1}. Interaction of varieties and seed rates did not have significant influence on the shelling percentage.

100 kernel weight: The differences between the varieties for the 100 kernel weight were significant. Among the five varieties tested, Kadiri Harithandra resulted in significantly higher 100 kernel weight (56.5 g), but which was statistically on par with Kadiri Amaravathi. K-6 recorded significantly the lowest 100 kernel weight (68.1 g). The reason is that the difference between the varieties for the 100 kernel weight originated from their genetic background. Seed rates as well as interaction between varieties and seed rates were failed to influence the 100 kernel weight.

Dry Pod yield: Significant variation was observed in pod yield among different varieties (Table 2). Among the varieties tested, the highest dry pod yield (2309 kg ha^{-1}) was recorded with Kadiri Harithandra, but it was statistically on par with Dharani, Kadiri Amaravathi and K-9. While the lowest pod yield of 1106 kg ha^{-1} was recorded with K-6 (Table 2). The highest pod yield produced by variety 'Kadiri Harithandra' could be attributed to its higher 100 pod and kernel weight. Golluoglu *et al*. (2016) [6] reported that the reason of these differences between the varieties for the pod yield could be originated from their genetic background. Significant variation was observed in pod yield among the seed rates. The highest pod yield (2270 kg ha^{-1}) was recorded with 270 kg ha^{-1}, while the lowest pod yield of 1938 kg ha^{-1} was recorded with seed rate of 315 kg ha^{-1}. Increase in pod yield with increasing seed rate up to 270 kg ha^{-1} could be attributed to added pod production by the additional plants per square meter. Interaction between varieties and seed rates did not any have any significant influence on the pod yield.

Dry haulm yield: Haulm yield was significantly influenced by varieties, seed rates and their interaction. Among the varieties Kadiri Amaravathi resulted in significantly highest haulm yield. The lowest haulm yield was recorded with K-6. Among the different seed rates the highest haulm yield was recorded with 315 kg ha^{-1}, but which was on par with 270 kg ha^{-1}. This might be due to more number of plants per unit area. Interactions between varieties and seed rates have significant influence on the haulm yield. Significantly the highest haulm yield was recorded with Kadiri Amaravathi at 315 kg ha^{-1} (Table 3).

Table 1: Plant height (cm) and yield parameters as influenced by varieties and seed rates

Treatment	Plant height (cm)h	No. of pods per plant	100 dry pod weight (g)	Shelling (%)	100 kernel wt. (g)
Varieties					
Dharani	25.12	10	118.0	75.0	47.7
Kadiri Amaravathi	25.05	11	133.4	68.7	56.4
Kadiri Harithandra	17.70	9	141.5	75.4	56.5
K-9	25.10	18	99.2	80.5	50.3
K-6	32.46	10	102.0	68.1	42.6
S. Em ±	1.43	0.68	4.78	1.06	0.94
CD ($P \leq 0.05$)	4.74	2.3	15.8	3.5	3.1
Seed rates					
180 kg ha^{-1}	23.38	15	125.4	74.1	52.9
225 kg ha^{-1}	24.38	12	122.2	74.9	50.5
270 kg ha^{-1}	26.08	10	116.8	73.1	50.2
315 kg ha^{-1}	26.50	8	110.7	71.9	49.2
S. Em ±	1.47	0.85	2.18	0.7	1.07
CD ($P \leq 0.05$)	N.S.	3	6.3	2.0	N.S.
Interaction	N.S.	N.S.	N.S.	N.S.	N.S.

Table 2: Pod and haulm yield (kg ha^{-1}) as influenced by varieties and seed rates

Treatment	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Varieties		
Dharani	2288	4284
Kadiri Amaravathi	2257	6261
Kadiri Harithandra	2309	3516
K-9	2208	2686
K-6	1126	3142
S. Em ±	144.5	285
CD ($P \leq 0.05$)	479	945
Seed rates		
180 kg ha^{-1}	1945	3701
225 kg ha^{-1}	1998	3809
270 kg ha^{-1}	2270	4098
315 kg ha^{-1}	1938	4304
S. Em ±	76.7	139
CD ($P \leq 0.05$)	223	402
Interaction	N.S.	Significant

Table 3: ± Interaction of varieties and seed rates on haulm yield (kg ha^{-1})

Varieties/ Seed rates	Dharani	Kadiri Amaravathi	Kadiri Harithandra	K-9	K-6	Mean
180 kg ha^{-1}	4306	5761	3101	2660	2675	3701
225 kg ha^{-1}	3703	6320	3160	2572	3292	3809
270 kg ha^{-1}	5129	5600	3762	2984	3013	4097
315 kg ha^{-1}	3997	7363	4042	2528	3588	4304
Mean	4284	6261	3516	2686	3142	
			S. Em ±		CD ($P \leq 0.05$)	
Crop geometry at the same varieties			570.4		967	
Varieties at the same level spacing			391.6		1222	

Conclusion

In southern agro climatic zone of Andhra Pradesh during *rabi* season the ground nut variety Kadiri Harithandra was found suitable with the optimum seed rate of 270 kg ha^{-1}.

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