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Response of new groundnut entry K 1641 to Spacing and nutrients in vertisol during rainy season under rainfed farming

B.S. Yenagi*, H. L. Nadaf, M.G. Hegde and I. V. Goudar

All India Coordinated Research Project on Groundnut,
Main Agricultural Research Station, UAS, Dharwad-580 005, Karnataka, India.
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ABSTRACT

A field experiment was conducted during rainy season of 2014 under All India Coordinated Research Project on Groundnut at University of Agricultural Sciences, Dharwad, Karnataka to find out the effect of spacing and nutrient on AVT groundnut cultivar K 1641 in black soils under rainfed condition. The highest pod yield (3578 kg/ha) was found in the K 1641 as compared to check variety TGLPS 3(3194 Kg/ha). A plant spacing of 30 cm x 10 cm gave the highest pod (3845 Kg/ha) as compared to wider intra row spacing (30 cm x 20cm) (2927 kg/ha). Among the nutrient management practices, recommended dose (100%) of NPK resulted in significantly higher pod yield (3488 kg/ha) as compared to 50% recommended dose of NPK (3120 kg/ha) and failed to respond to higher level (150%) of recommended dose of NPK (3549 kg/ha). Whereas, Cultivar K 1641 responded to higher dose of nutrient application i.e. Application of FYM @ 7.5 t ha^{-1} + 150 % RDNPK (37.5 kg N, 112.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1}) and registered higher net monetary returns(Rs.103013 ha^{-1}) and B:C ratio (2.88).

Key words: Economics, Groundnut, Nutrient management practices, Spacing, Variety, Yield

Groundnut belongs to family Leguminoceae (Fabaceae) subfamily Papilionoideae, genus *Arachis* is morphologically well defined and clearly delineated from its closest relatives by the presence of geocarpic peg. In India, groundnut is cultivated largely in *kharif* season (June to October) under rainfed conditions with low input use and high pressure of insect-pests and diseases including weeds, hence, the productivity is low. Six States namely Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Rajasthan and Tamil Nadu account for about 90% of the total groundnut area of the country. The area under groundnut in the country is 5.53 million hectares with production of 9.67 million tons of unshelled nuts and productivity is 1750 kg ha^{-1}. In Karnataka, groundnut is being grown in an area of 7.25 lakh hectares with production of 6.58 lakh tones and productivity is 908 kg ha^{-1}(Anonymous, 2014). This indicates large yield gap from 908 to 1750 kg/ha. The most important factor limiting production of groundnut at farmer's perspective is lack of desirable plant population i.e., sub-optimal plant population (especially the practice of wide spacing) coupled with local non potential low yielding cultivar. Further, groundnut being legume in nature and not responds to higher level of nutrient application. Majority of the stake holders use low rates or seldom few farmers use high rate of nutrients. Since, groundnut is famous as an unpredictable legume, because a satisfactory over ground vegetative growth may not necessarily match with the pod formation below the soil surface but it has ability to thrive on all types of soils including clayey soils. The northern transitional zone (8) of Karnataka is one of the high potential areas for groundnut production under vertisol which are rich in clay during *kharif* season with assured south west rainfall. It is recognized that the optimal combination of a genotype, proper plant population and nutrient use can enhance the productivity of groundnut, necessary to satisfy the demands of increasing world's population. Hence, the field experiment was undertaken to find out the effect of spacing (plant population), optimum nutrient dose and their interaction on new improved groundnut genotype K 1641 developed under crop improvement programme of ICAR-Directorate of Groundnut Research's All India Coordinated Research Project.

The field experiment was carried out in Northern Transitional Zone (Zone 8) of Karnataka at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka, India during *kharif* season of 2014 to study the production potentiality of AVT groundnut entry K 1641 under different spacing and fertility levels in vertisols under rainfed condition. The soil of the experimental field was medium black clayey in texture with organic carbon of 0.51 per cent, available phosphorus of 32.90 kg/ha and potassium of 387.00 kg/ha. The pH of the soil was 7.80. The experiment was laid out in split-split plot design with three replications. The main plot treatments comprised of

*Corresponding author's e-mail: yenagibs@uasd.in

two varieties i.e., V_1-K 1641(AVT entry) and V_2-TGLPS 3(Local check). The sub plot treatments comprised of two levels of spacing *viz.*, S_1 – 30 x 10 cm (333,333 plants ha^{-1}) and S_2 – 30 x 20 cm (166,666 plants ha^{-1}). The sub-sub plot treatments comprised of three levels of fertilizer doses *viz.*, NM_1–Application of FYM @ 7.5 t ha^{-1} + 50% RDNPK, NM_2–Application of FYM @ 7.5 t ha^{-1} + 100% RDNPK and NM_3–Application of FYM @ 7.5 t ha^{-1} + 150% RDNPK. The 100 per cent recommended dose of fertilizer (RDF) was 25 kg of N + 75 kg of P_2O_5 + 25 kg of K_2O ha^{-1}. Gypsum @ 500 kg ha^{-1} was applied uniformly to all the treatments. The pre-emergence application of herbicide pendemethilin @ 3.3 1ml l^{-1} of water was applied (500 liters of spary volume ha^{-1}) followed by one hand weeding at 25 days after sowing(DAS) and two intercultivations at 30 and 45 DAS. Seeds were treated biofertlizer(*Rhizobium* and Phosphate Solublizing Bacteria) followed by carboxin 37.5% + thiram 37.5% WS(systemic and contact fungicide) @ 2 g kg^{-1} of seed to address seed and soil borne diseases.

Weather situation: Northern Transitional Zone (Zone 8) of Karnataka though received normal rainfall during 2014 but onset delayed by nearly by one and half month. The total amount of rainfall received at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during 2014 (January to December) was 968.8 mm (70 rainy days). The pre-monsoon rainfall received during the months of April 2014 and May 2014 was 242.3 mm (10 rainy days). Good rainfall during the months of April 2014 and May 2014 facilitated good land preparation. But shortfall of rainfall to the extent of 70 per cent during June 2014 resulted in delayed sowing on 17.07.2014. Germination and crop stands were good. The crop did not receive any type of moisture stress except excessive soil moisture situation during early crop period. The rainfall received during the period from 0 to 30 days after sowing (DAS), 31 to 60 DAS, 61 to 90 DAS and 91 to harvest (101 to 113 days) of groundnut was 280.2 mm (21 rainy days), 111.6 mm (15 rainy days), 115.4 mm (08 rainy days) and 64.0 mm (03 rainy days), respectively. Groundnut crop was harvested on 05-11-2014(112 days). Total rain received during the crop growth period from sowing to harvest was 571.2 mm in 47 rainy days. Though crop has experienced excessive soil moisture stress during its initial crop growth stages, later due to optimum rainfall during the critical crop growth period resulted in normal yields of groundnut. Normal yield of groundnut under late sown condition was also reported by Chandrika *et al.*, 2008 in southern agro-climatic zone of Andhra Pradesh.

Insect pests and disease situation: Incidence of *Spodoptera litura* and other defoliators on groundnut was low during *kharif* 2014. First time incidence of *Maruca vitrata* was seen during September 2nd week. The incidence of sucking pests (Thrips and Leaf hoppers) was less to nil. There was no collar rot incidence during this year but stem rot incidence did appear. Late leaf spot and rust diseases were low. Both insect pests and diseases on groundnut were timely managed with appropriate plant protection measures (Seed and soil borne diseases through seed treatment, rust and late leaf spot with tebuconazole 250 EC(0.1%) and *Spodoptra litura, Helicoverpa and Maruca vitrat with* quinalphos 25 EC(0.2%) and emamectin benzoate 5% SG (0.02%)).

Performance of cultivars: Cultivars differed significantly with respect to dry pod and kernel yield. Cultivar K 1641 produced 12.02 %(3578 kg ha^{-1}) and 17.80 % (2640 kg ha^{-1}) higher dry pod yield and kernel yield over cultivar TGLPS 3 (3194 kg ha^{-1} and 2241 kg ha^{-1}) (Table 1). It was mainly attributed to significantly higher number of branches per plant, number of pods per plant, dry pod weight per plant, shelling percentage and harvest index with cultivar K 1641. Economics of groundnut production revealed that cultivar K 1641 produced significantly higher net returns and higher B: C ratio (Rs. 91036 ha^{-1} and 2.73, respectively) as

Table 1: Plant height, number of pods plant^{-1}, total number of pods plant^{-1}, dry pod weight, dry pod yield, kernel yield and dry haulm yield of groundnut cultivars at harvest as influenced by spacing and nutrient management practices

Treatments	Plant height (cm)	Number of branches plant^{-1}	Total number of pods plant^{-1}	Dry pod weight(g plant^{-1})	Dry pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Dry haulm yield(kg ha^{-1})
Cultivars							
K 1641	29.81	6.29	15.71	17.93	3578	2640	4502
TGLPS 3	29.87	6.14	15.10	16.51	3194	2241	4417
CD at 5%	NS	0.10	0.55	NS	148	64	NS
Spacing							
30 cm ´ 10 cm	31.33	6.02	15.28	16.17	3845	2756	4972
30 cm ´ 20 cm	28.34	6.41	15.53	18.27	2927	2125	3947
CD at 5%	1.38	NS	NS	1.00	403	311	603
Nutrient management practices (NM)							
NM_1	29.30	5.98	14.72	16.06	3120	2222	4368
NM_2	29.88	6.12	15.47	17.68	3488	2498	4440
NM_3	30.24	6.55	16.03	17.91	3549	2601	4571
CD at 5%	NS	NS	NS	NS	NS	NS	NS

NM_1 - FYM @ 7.5 t ha^{-1} + 50 % RDNPK (12.5 kg N, 37.5 kg P_2O_5 and 12.5 kg K_2O ha^{-1}), **NM_2** - FYM @ 7.5 t ha^{-1} + 100 % RDNPK (25 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1})**NM_3** - FYM @ 7.5 t ha^{-1} + 150 % RDNPK (37.5 kg N, 112.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1})

Table 2: Shelling per cent, 100-kernel weight, sound mature kernels, harvest index, cost of cultivation, gross monetary returns, net monetary returns and benefit: cost ratio of groundnut cultivars at harvest as influenced by spacing and nutrient management practices

Treatments	Shelling per cent	100- Kernel weight (g)	Sound mature kernels (%)	Harvest index (HI)	Cost of cultivation (Rs ha^{-1})	Gross monetary returns (Rs ha^{-1})	Net monetary returns(Rs ha^{-1})	Benefit : Cost Ratio
Cultivars								
K 1641	73.33	61.70	95.33	0.325	52082	143117	91036	2.73
TGLPS 3	70.23	59.43	93.79	0.294	52082	127778	75696	2.45
CD at 5%	3.47	NS	NS	0.006	-	5903	5903	0.12
Spacing								
30 cm ´ 10 cm	71.55	59.96	93.79	0.311	54144	153817	99673	2.84
30 cm ´ 20 cm	72.42	61.17	95.90	0.309	50019	117078	67059	2.34
CD at 5%	NS	NS	2.13	NS	-	16133	16133	0.30
Nutrient management practices (NM)								
NM_1	71.19	59.42	93.97	0.296	49769	124833	75065	2.50
NM_2	71.59	60.20	94.47	0.315	52082	139534	87452	2.67
NM_3	73.16	62.07	95.24	0.319	54395	141975	87581	2.60
CD at 5%	NS	NS	NS	NS	-	NS	NS	NS

NM_1 - FYM @ 7.5 t ha^{-1} + 50 % RDNPK (12.5 kg N, 37.5 kg P_2O_5 and 12.5 kg K_2O ha^{-1}), **NM_2 -** FYM @ 7.5 t ha^{-1} + 100 % RDNPK (25 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1})**NM_3 -** FYM @ 7.5 t ha^{-1} + 150 % RDNPK (37.5 kg N, 112.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1})

compared to cv. TGLPS 3(Rs. 75696 ha^{-1} and 2.45, respectively). Further, cultivar K 1641exhibited dark green foliage and showed tolerance to foliar diseases such as late leaf spot and rust. Positive correlation between yield components and yield was reported by Sandhya Kiranmai *et al.,* (2015) in studies on correlation and path analysis in groundnut under different environment.

Effect of spacing: Spacing had significant effect on dry pod and kernel yield of groundnut. Plant spacing of 30 cm x 10 cm (333,333 plants/ha) produced 21.36 % higher dry pod yield and 29.69% higher kernel yield over a plant spacing of 30 x 20 cm(1,66,667 plants ha^{-1}) (2927 kg dry pod yield ha^{-1} and 2125 kg kernel yield ha^{-1}, respectively). This might be due to optimum plant population to enhance the yield attributing characters which ultimately reflected in yields of groundnut. Groundnut with a spacing of 30 cm ´ 10 cm produced significantly higher net returns and higher B: C ratio (Rs. 99,673 ha^{-1} and 2.84, respectively) as compared to spacing of 30 cm ´ 20 cm (Rs. 67,059 ha^{-1} and 2.34, respectively). Though number of branches and pods per plant, dry pod weight per plant, shelling per cent, sound mature kernels and 100 kernel weight were higher with spacing of 30 cm ´ 20 cm (1,66,667 plants ha^{-1}) but is not exhibited on yield per unit area. This was probably because the additional plants in the closely spaced crop more than compensated for the reduced number of pods per plant (Konlan *et al*., 2013).

Effect of nutrient management practices: Effect of nutrient management practices on dry pod and kernel yields of groundnut were significant. Application of FYM @ 7.5 t ha^{-1} + 100 % RDNPK (25 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1}) (Recommended nutrient management practices) produced 11.76 % significantly higher dry pod yield(3488 kg ha^{-1})and 12.42 % significantly higher kernel yield(2498 kg ha^{-1}) over application of FYM @ 7.5 t ha^{-1} + 50 % RDNPK (12.5 kg N, 37.5 kg P_2O_5 and 12.5 kg K_2O ha^{-1}) (Recommended nutrient management practices) (3120 kg dry pod and 2222 kg kernel yield ha^{-1}, respectively). Groundnut failed to respond to higher doses of nutrient application i.e., Application of FYM @ 7.5 t ha^{-1} + 150 % RDNPK (37.5 kg N, 112.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1}). Hosamani and Janawade (2006) reported that 100 % RDF recorded the highest pod yield of groundnut. They also reported that beyond 100% RDF application to groundnut, pod yield decreased gradually. Similar trend was also observed in haulm yield of groundnut. Linear positive response of groundnut varieties to added nutrients was also reported by Yenagi *et al*., 2015 and Singh et al., 2011. Application of FYM @ 7.5 t ha^{-1} + 150 % RDNPK (37.5 kg N, 112.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1}) produced higher net monetary returns(Rs. 87581 ha^{-1}). Whereas application of FYM @ 7.5 t ha^{-1} + 100 % RDNPK (25 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1}) recorded higher B: C ratio (2.67) (Table 2).

CONCLUSION

Groundnut cultivar K 1641 could be grown during rainy season with application of FYM @ 7.5 t ha^{-1} + 150 % RDNPK (37.5 kg N, 112.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1}) and 30 cm X 10 cm plant spacing for getting higher yield with sustaining soil fertility under northern transitional zone (8) of Karnataka state.

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