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Effect of Plant Population and Fertilizer Doses on Yield Attributes, Yield and Economics of Summer Groundnut

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A B S T R A C T

A field experiment was conducted at Agricultural Research Station, Shirgaon, Ratnagiri (MS) on the lateritic soil during Rabi 2013-14 to 2015-16 to study effect of plant population and fertilizer doses on growth and yield of summer groundnut. The treatment comprises four main plot treatments of planting geometry and three sub-plot treatments of levels of fertilizer replicated three times in split plot design. Groundnut cultivar, TKG Bold sown with planting geometry 20 X 10 cm (plant population @ 5 lakhs ha^{-1}) with application of 125% RDF level noticed significantly highest pod, kernel and haulm yield of groundnut, which was followed by planting geometry 25 X 10 cm (plant population @ 4.0 lakhs ha^{-1}), 30 X 10 cm (plant population @ 3.33 lakhs ha^{-1}) and 30 X 15 cm (plant population @ 2.22 lakhs ha^{-1}) with same fertilizer level i.e.125% RDF. The groundnut cultivar, TKG Bold sown with planting geometry 30 x15 cm (Plant Population of 2.22 lakhs ha^{-1}) and fertilized with 125% RDF level (P_1F_3) recoded significantly highest number of pods plant^{-1} and pod weight plant^{-1} over rest of treatment combinations. However, the highest benefit to cost ratio was observed in planting geometry 30 X 15 cm with 125% RDF level (P_1F_3).

Introduction

Groundnut (*Arachis hypogaea* L.) is a major oilseed crop in India. Its seed contain high quality of 45-50% edible oil, 25-30% digestible protein, 20% carbohydrates, and 5% fiber and ash which make a sustainable contribution to human nutrition (Fageria *et al.,* 1997). Groundnut is considered as poor man's almond and also called as "King of oilseeds". It is cultivated in India over 45.97 million ha area with the production of 67.33 million tonnes (both kharif and rabi) and average productivity of 1.47 t ha^{-1} (Indiastat, 2016). In Maharashtra, groundnut cultivated (both kharif and rabi) over an area of 3.09

million ha with production of 3.34 million tonnes having productivity of 1.08 t ha^{-1} (Indiastat, 2016). The area under groundnut crop in konkan was about more than 15,000 ha with 1,550 kg ha^{-1} productivity during 2013-14 (Anonymous, 2013).

Planting geometry is an important agronomical management practice and non-monetary input, which has key role in increased crop production. Crop planted in appropriate geometry enhances use of natural resources as well as inputs given to the crop. Groundnut crop competes with each other

above and below the ground. Planting geometry varies according to species and region. Similarly, appropriate fertilizer dose is also an important aspect regarding crop production. Supplying nutrients in required quantity and fulfills crop need, increases the potential of cultivar. Study of different levels of fertilizer to crop helps to standardize the fertilizer dose for getting profitable yield. Groundnut variety TKG-Bold (*Trombay Konkan Groundnut-Bold'*) is promising, semi spreading and bold seeded variety. This variety is popular among the farmers. So therefore it is necessary to find appropriate planting geometry and fertilizer dose for getting profitable yield. Hence therefore the present investigation was undertaken.

Materials and Methods

The present investigation was conducted at Agricultural Research Station, Dr. B.S. Konkan Krishi Vidyapeeth, Shirgaon, Dist. Ratnagiri (MS) during the three successive *rabi* seasons from 2013-14 to 2015-16 with Groundnut cultivar *Trombay Konkan Groundnut-Bold' (TG 19A)*. The experiment was laid out in split plot design replicated three times. The main plot treatment consists of four planting geometry *viz.*, P_1: Plant Population @ 2.22 lakhs ha^{-1} (30 x15 cm), P_2: Plant Population @ 3.33 lakhs ha^{-1} (30 x 10 cm), P_3: Plant Population @ 4.0 lakhs ha^{-1} (25 x 10 cm) and P_4: Plant Population @ 5.0 lakhs ha^{-1} (20 x 10 cm). However, sub plot treatments consist of three levels of fertilizers *viz.*, F_1: 75 % RDF, F_2: 100 % RDF and F_3: 125 % RDF. The soil was sandy loam in texture and acidic in reaction (pH 5.2), low in available nitrogen (277.2 kg ha^{-1}), phosphorus (13.3 kg ha^{-1}) and medium in available potassium (186.5 kg ha^{-1}). Groundnut seed was sown at the rate of 125 kg ha^{-1} with spacing as per treatments. In nutrient management, urea was applied as source of nitrogen while Single Super Phosphate (SSP)

for phosphorus. All these treatments were imposed as per the schedule and statistical data of these variables obtained during the course of investigation were analyzed by analysis of variance method as per the procedure (Split plot design) described by Gomez and Gomez (1983) and Panse and Sukhatme (1985).

Results and Discussion

Ancillary growth and yield attributes

Pooled data presented in Table 1 indicates that, plant height, number of branches plant^{-1}, number of pods plant^{-1} and pod weight plant^{-1} were significantly influenced due to different planting geometry. Groundnut sown at widely spaced plant population of 2.22 lakhs ha^{-1} (30 x15 cm) had significantly highest growth and yield attributing characters over rest of planting geometry. This was due to more space associated with plant, which leads to more growth and yield attributes. However, plant height was significantly higher in closely spaced Plant Population of 5.0 lakhs ha^{-1} (20 x 10 cm) over rest of planting geometry. This is due to more competition among the plant for sunlight, nutrients and space. These results are in hormone with the findings of Haricharan Reddy *et al.,* (2014), Meena (2011) and Morshed Alam *et al.,* (2002).

There was significant difference observed for plant height, number of pods plant^{-1} and pod weight plant^{-1} of groundnut due to different levels of fertilizer treatments under study. Groundnut fertilized with 125 % RDF noticed significantly highest plant height (50.1 cm), number of pods plant^{-1} (16.4) and pod weight plant^{-1} (21.9 g) of groundnut over rest of levels of fertilizer. However, number of branches plant^{-1} does not differed due to levels of fertilizer. Similar results were reported by Jakusko and Dakato (2015).

Table.1 Plant height, number of branches, total number of pods and pod weight per plant of groundnut at harvest as influenced by different treatments under summer season (Pooled data of three years)

Treatments	Plant height (cm) at harvest				No. of branches plant[-1]				Total number of pods plant[-1]				pod weight (g plant[-1])			
	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean
P1 : (30 x15 cm)	44.0	45.2	47.5	**45.6**	2.89	3.11	3.18	**3.06**	14.9	16.4	20.0	**17.1**	20.0	22.2	26.6	**23.0**
P2 : (30 x10 cm)	44.5	45.5	47.5	**45.8**	2.87	2.96	3.11	**2.98**	14.7	16.1	17.9	**16.2**	19.8	20.3	23.8	**21.3**
P3 : (25 x10 cm)	46.7	48.3	51.7	**48.9**	2.82	2.87	2.84	**2.84**	13.2	13.7	14.9	**13.9**	16.6	19.3	21.7	**19.2**
P4 (20 x10 cm)	47.4	50.7	53.7	**50.6**	2.76	2.62	2.73	**2.70**	10.2	12.1	12.8	**11.7**	13.6	15.3	15.7	**14.9**
Mean	**45.6**	**47.4**	**50.1**	**47.7**	**2.83**	**2.89**	**2.97**	**2.90**	**13.3**	**14.6**	**16.4**	**14.7**	**17.5**	**19.3**	**21.9**	**19.6**
Comparing the means of	S.E. +		LSD (0.05)		S.E. +		LSD (0.05)		S.E. +		LSD (0.05)		S.E. +		LSD (0.05)	
Planting Geometry (P)	0.7		2.0		0.06		0.17		0.3		0.9		0.4		1.2	
Fertility levels (F)	0.5		1.4		0.05		NS		0.3		0.7		0.3		0.8	
Int. P X F	1.0		2.8		0.11		NS		0.5		1.5		0.6		1.7	
C.V. % (P and F)	7.4		6.1		10.08		11.39		10.2		10.6		10.7		9.1	

Table.2 Dry pod yield, kernel yield, haulm yield and harvest index of groundnut as influenced by different treatments under summer season (Pooled data of three years)

Treatments	Dry pod yield (kg ha^{-1})				Kernel yield (kg ha^{-1})				Haulm yield (kg ha^{-1})				Harvest Index			
	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean
P1 : (30 x15 cm)	2367	2812	3172	**2784**	1674	2013	2302	**1996**	2820	3268	3802	**3296**	0.32	0.33	0.33	**0.33**
P2 : (30 x10 cm)	2689	3005	3317	**3004**	1900	2137	2377	**2138**	3033	3371	3828	**3411**	0.33	0.34	0.33	**0.33**
P3 : (25 x10 cm)	2810	3229	3488	**3175**	1970	2279	2470	**2240**	3390	3728	4060	**3726**	0.32	0.33	0.33	**0.32**
P4 (20 x10 cm)	3177	3434	3635	**3415**	2189	2394	2555	**2379**	3598	3948	4413	**3986**	0.32	0.32	0.32	**0.32**
Mean	**2761**	**3120**	**3403**	**3094**	**1933**	**2206**	**2426**	**2188**	**3210**	**3579**	**4026**	**3605**	**0.32**	**0.33**	**0.33**	**0.33**
Comparing the means of	S.E. +		LSD (0.05)		S.E. +		LSD (0.05)		S.E. +		LSD (0.05)		--		--	
Planting Geometry (P)	50		148		33		99		64		189		--		--	
Fertility levels (F)	33		95		24		69		51		146		--		--	
Int. P X F	67		190		49		139		103		293		--		--	
C.V. % (P and F)	8.4		6.5		7.9		6.7		9.2		8.6		--		--	

Table.3 Economics of groundnut production as influenced by different treatments (Mean data of three years)

Treatments	Cost of cultivation (Rs ha⁻¹)				Gross returns (Rs ha⁻¹)				Net returns (Rs ha⁻¹)				B:C ratio			
	F_1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F_1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F_1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean	F_1 : 75 % RDF	F2 : 100 % RDF	F3 : 125 % RDF	Mean
P_1 : (30 x15 cm)	72481	79504	87119	**79701**	124011	147139	166181	**145777**	51530	67635	79062	**66076**	1.71	1.85	1.91	**1.82**
P_2 : (30 x10 cm)	83697	90050	97248	**90332**	140498	156976	173521	**156998**	56801	66927	76272	**66667**	1.68	1.74	1.78	**1.74**
P_3 : (25 x10 cm)	91026	99064	106190	**98760**	147265	168886	182511	**166221**	56239	69822	76321	**67461**	1.62	1.70	1.72	**1.68**
P_4 (20 x10 cm)	103493	109421	115691	**109535**	166029	179607	190583	**178740**	62536	70186	74892	**69205**	1.60	1.64	1.65	**1.63**
Mean	**87674**	**94510**	**101562**	**94582**	**144451**	**163152**	**178199**	**161934**	**56776**	**68643**	**76637**	**67352**	**1.65**	**1.74**	**1.76**	**1.72**

Produce and input rates

Rabi Season	Pod yield (Rs kg⁻¹)	Haulm (Rs kg⁻¹)	N (Rs kg⁻¹)	P_2O_5 (Rs Kg⁻¹)	FYM (Rs tonne⁻¹)	Labour charges (Rs. day⁻¹)
2013-14	45	1.50	10.80	21.00	1000	162
2014-15	45	1.50	12.26	37.50	1000	180
2015-16	50	2.0	12.26	37.50	1000	180

Treatments	Seed rate in pods (kg/ha)
P_1: Plant Population @ 2.22 lakhs ha⁻¹ (30 x15 cm)	200
P_2: Plant Population @ 3.33 lakhs ha⁻¹ (30 x10 cm)	300
P_3: Plant Population @ 4.0 lakhs ha⁻¹ (25 x10 cm)	360
P_4: Plant Population @ 5.0 lakhs ha⁻¹ (20 x10 cm)	450

Yield

The pooled data (Table 2) revealed that groundnut variety, TKG Bold was sown with planting geometry of 20 X 10 cm i.e. plant population @ 5 lakhs ha^{-1} (P$_4$) recorded the significantly highest pod, kernel and haulm yield (3415 kg, 2379 kg and 3986 kg ha^{-1}, respectively) over rest of the planting geometries. However, groundnut sown with planting geometry P$_2$ i.e. plant population @ 3.33 lakhs ha^{-1} (30 X 10) (3004 kg, 2138 kg and 3411 kg ha^{-1}, respectively) was at par with P$_1$ planting geometry i.e. plant population @ 2.22 lakhs ha^{-1} (30 X 15) (2784 kg, 1996 kg and 3296 kg ha^{-1}, respectively) for haulm yield of groundnut. These results are in line as reported by Reddy *et al.,* (2014)

Application of 125% RDF (F$_3$) to groundnut crop recorded significantly highest pod, kernel and haulm yield (3403, 2426 and 4026 kg ha^{-1}, respectively) over 100% RDF (F$_2$) (3120, 2206 and 3579 kg ha^{-1}, respectively) and 75% RDF (F$_1$) level (2761, 1933 and 3210 kg ha^{-1}, respectively). The use of 75% RDF recorded the least pod, kernel and haulm yield of groundnut. Application of N and P fertilizers influences the yield of the crop. Fertilizers promotes vegetative as well as root growth and increases the yield of groundnut (Jakusko and Dakato, 2015). Dadson and Petkov (1976) reported that the high application of nitrogen application is required for high yield of the crop.

Economics

The maximum net returns of Rs. 69,205/- ha^{-1} was observed with planting geometry P$_4$ i.e. plant population @ 5 lakhs ha^{-1} (20 X 10 cm), however the highest cost to benefit ratio of 1:1.82 was noticed with plant population @ 2.22 lakhs ha^{-1} (30 X 15 cm) i.e. P$_1$. These results are in conformity with findings of Meena (2011)

In case of levels of fertilizers, maximum net monitory returns of Rs. 76,637/- ha^{-1} with higher cost to benefit ratio (1:1.76) was noticed under use of 125% RDF fertilizer level (Table 3).

Interaction effect

Interaction effect between planting geometries and fertility levels was found to be significant in respect of plant height, number of pods plant^{-1} and pod weight plant^{-1} of groundnut. The groundnut variety, TKG Bold sown with planting geometry P$_1$ i.e. 30 x15 cm (Plant Population of 2.22 lakhs ha^{-1}) and fertilized with 125% RDF level (P$_1$F$_3$) recoded significantly highest number of pods plant^{-1} (20.0) and pod weight plant^{-1} (26.6 g) over rest of treatment combinations. Whereas planting geometry P$_4$ i.e. 20 X 10 cm (plant population @ 5 lakhs ha^{-1}) with application of 125% RDF level (P$_4$F$_3$) recorded significantly highest plant height (53.7) over rest of treatment combinations.

Similarly, interaction effect between planting geometries and fertility levels was found to be significant in respect of pod, kernel and haulm yield of groundnut. The groundnut cultivar, TKG Bold sown with planting geometry, P$_4$ i.e. 20 X 10 cm (plant population @ 5 lakhs ha^{-1}) with application of 125% RDF level (P$_4$F$_3$) recorded significantly maximum pod, kernel and haulm yield (3635, 2555 and 4413 kg ha^{-1}, respectively) over all other treatment combinations, but was at par with treatment combination (P$_3$F$_3$) i.e. groundnut sown by 25 X 10 cm planting geometry and fertilized with 125% RDF, for pod and kernel yield (3488 and 2471 kg ha^{-1}, respectively) of groundnut.

Groundnut cultivar, TKG Bold was sown with planting geometry, P$_4$ i.e. 20 X 10 cm (plant population @ 5 lakhs ha^{-1}) with application of 125% RDF level noticed highest pod yield

(3635 kg ha^{-1}) of groundnut, which was followed by planting geometry P$_3$ i.e. 25 X 10 cm (3488 kg ha^{-1}), P$_2$ i.e. 30 X 10 cm (3317 kg ha^{-1}) and P$_1$ i.e. 30 X 15 cm (3172 kg ha^{-1}) with same fertilizer level i.e.125% RDF. However, the highest cost to benefit ratio (1:1.91) observed in planting geometry P$_1$ i.e. 30 X 15 cm with 125% RDF level.

Hence it was concluded that to obtain higher profitability from *rabi* summer season, the groundnut cultivar, TKG Bold be sown with planting geometry of 30 X 15 cm (plant population @ 2.22 lakhs ha^{-1}) with application of 125% RDF with highest cost to benefit ratio of 1:1.91 under South Konkan Coastal zone of Maharashtra.

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