Contemporary Approach for Higher Yield and Productivity of *Kharif* Groundnut (*Arachis hypogaea* L.) in *Konkan*

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Abstracts

Field investigation was conducted during kharif seasons of 2013 to 2015 on lateritic soils of konkan to study consequence of land configuration and mulching on productivity and resource use efficiency of kharif groundnut. The experiment consists of four land configuration and three mulching treatments. The pooled result revealed that, growth and yield of groundnut was significantly influenced due to application of different land configuration and mulching treatments under study. Dry pod yield of groundnut crop was recorded significantly highest with broad bed and furrow method (80-20 cm) of land configuration i.e. 2477 kg ha^{-1} over rest of land configurations whereas, under transparent polythene film (7 micron) mulch it was (2500 kg ha^{-1}) over other mulching treatments. Similar kind of trend was noticed for kernel and haulm yield of groundnut. Economics of the treatments revealed that, groundnut sowing on broad bed and furrow remain topped, in rank for net returns of ₹ 31,392 ha^{-1}) with high benefit to cost ratio of 1: 1.41. However, groundnut sowing with transparent polythene mulching furnished higher net returns of ₹ 26,341 ha^{-1} with benefit to cost ratio 1:1.32 followed by use of paddy straw mulching which was ₹ 17,597 ha^{-1} with 1:1.23 B:C ratio)

Keywords: Economics, groundnut, land configuration, mulching.

Introduction

To meet the ever increasing demand of vegetable oil, improvement of production of major oilseed crops through area expansion and productivity by adoption of improved technology is most important. Among the oilseed crops groundnut is the king contributing about 45% of total area and 55% of total production under oilseeds in the country. Groundnut (*Arachis hypogaea* Linn.) is the fore most important oil seed crop of India. It is used not only as edible oil, but also in manufacture of soaps, hydrogenated vegetable oil, toilet requisites and for culinary purpose at well. The kernels are rich in protein and vitamins *viz.,* A, B_1, B_2 and E and the cake is rich in protein content (46 %) which is best source of animal as well as poultry feed and also good source of manure. Haulms rich in protein (10-12 %) are palatable and used as nutritional feed for cattle. The India, China, Nigeria, Senegal, Sudan, Burma and the United States of America are the major groundnut producing countries. However, out of the total area of 18.9 million hectares and the total production of 17.8 million tonnes in the world, these countries account for about 69 percent of the area and 70 percent of the production. India occupies the first place, both in regard to the area and the production in the world. About 7.5 million hectares are put under it annually and the production is about six million tonnes (Madhusudhana, 2013). But today the oil seed king is loosing some ground in competition with other oilseeds.

The loose and well aerated seed bed is very important as groundnut pods are grow underground, therefore loose soil surface is useful for easy penetration of pegs and development of pods. Thus crop has potential for increase in yield.

However, main impediment in extension of groundnut cultivation is lack of information on field layouts and water management technology. Also, presence of hard

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pan in soil profile impedes root growth and exploitation of water and nutrients. Moreover, broad bed and furrow technique provides loose soil mass for development of pods, besides this furrows are useful both for irrigation and drainage of excess water as groundnut is more sensitive to water fluctuations and more or less at critical groundnut stages adversely affect the yield (Patil *et al,* 2007). Broad Bed and Furrow (BBF) configuration maintains soil loose and porous and retain it congenial for better storage of rainwater and extensive root system which resulted better water and nutrient uptake by crop Vaghasia *et al*. (2007). The various experiments conducted at ICRISAT showed that increasing yield of groundnut can be obtained by growing it on broad bed furrow (Anonymous, 1987), Nalawade and More (1993) reported significant response of broad bed furrow technique resulting in higher pod yield.

The groundnut productivity has been improved by extensive use of polythene film for mulching under improved cultural practice. Various materials like straw, hay, trashes, dry leaves etc. have been used for long back as natural mulch to conserve soil moisture, arrest weed growth and improve in soil physical properties. However, in India, use of biodegradable transparent plastic film as mulch in agricultural field is still at a conceptual stage. Capitalizing the biodegradable transparent polythene film mulch technology is for revolutionizing groundnut yield. Therefore, *Konkan* condition warrant present investigation to cope up increasing groundnut growth and productivity so that, investigation untaken with exploiting different land configurations and mulching treatments on *kharif* groundnut on acid lateritic soils of *konkan*.

Materials and Methods

The present field investigation was undertaken at Agricultural Research Station, Shirgaon of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India during three consecutive *kharif* seasons from 2013 to 2015 using Groundnut cultivar *Trombay Konkan Groundnut-Bold' (TG 19A)*. The experiment was laid out in split plot design with twelve treatment combinations replicated three times. Main plot treatment consists of four land configurations *viz.,* conventional method, broad bed and furrow (80-20 cm), ridges and furrows and raised bed and furrow (30-30 cm). However sub plot consist three mulching treatments *viz.,* control (no mulch), paddy straw mulch and transparent polythene mulch (7 micron). The experimental soil was sandy loam in texture with slightly acidic in reaction (pH 6.1), low in available nitrogen (276.8 kg ha^{-1}), phosphorus (10.05 kg ha^{-1}) and high in available potassium (326.8 kg ha^{-1}). The land configuration *viz.,* Broad Bed Furrow were opened with help of plough having 80 cm top bed width with 20 cm furrow whereas, ridges and furrows were opened at every 50 cm distance. The, raised bed furrow opened in such a way that, they have 30 cm top width and 30 cm furrow. The white transparent 7 micron polythene mulch and organic mulch (paddy straw) was used as mulching material for experimentation. All the nutrient, disease and pest management practices were followed as per schedule and recommendation.

Results and Discussion

Effect of Land configuration

Ancillary and yield attributes : Pooled data presented in table 1 insinuates that, plant height, number of pods/plant, 100 kernel weight and shelling per cent were significantly influenced due to different land configuration treatments in groundnut cultivar TKG Bold. The groundnut sowing on broad bed and furrow, recorded significantly highest ancillary and yield attributing characters over conventional sowing method. However, number of pods $plant^{-1}$ was significantly higher in raised bed and furrow method of sowing but was at par with sowing on broad bed furrow method. Rao *et al*. (1991) reported that the dry matter, number of pods $plant^{-1}$ and shelling percentage of groundnut variety ICGS-11were significantly higher in BBF than in flat seed bed. Broad Bed and Furrow contributed to 21.9%more yield than the flat bed.

Table 1 : Effect of land configuration and mulching on yield attributes and yield of groundnut during different seasons.

Treatments	Dry Pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Plant height (cm)	Number of pods plant^{-1}	100 kernel weight (g)	Shelling per cent (%)
A) Land configuration							
L_1 : Conventional method	1814	1302	2416	54.1	13.6	57.8	71.7
L_2 : Broad bed and furrow method	2477	1797	2976	55.2	18.2	61.2	72.5
L_3 : Ridge and furrow method	1985	1410	2578	50.3	15.2	59.9	71.0
L_4: Raised bed and furrow (30 cm width with 30 cm furrow)	2228	1586	2794	53.8	18.4	60.0	71.2
S.E.±	37	26	54	1.0	0.4	0.4	0.2
CD at 5%	110	77	160	3.1	1.2	1.2	0.6
B) Mulching							
M_1 : Control	1700	1209	2347	49.8	13.8	57.6	71.0
M_2 : Organic mulch i.e. Paddy straw mulch	2177	1572	2715	52.3	17.2	60.8	72.2
M_3 : Transparent Polythene mulch	2500	1791	3011	57.9	18.0	60.9	71.6
SE ±	31	23	41	0.7	0.3	0.3	0.2
CD at 5%	87	64	118	2.1	0.8	0.9	0.6
C) Interaction effect							
SE ±	61	45	83	1.5	0.6	0.6	0.4
CD at 5%	173	129	236	NS	1.6	1.8	NS

Table 1.1 : Interaction effect between land configuration and mulching on dry pod yield (kg ha^{-1}) of groundnut (*Kharif* 2013, 2014, 2015 and pooled).

Treatments	Dry pod yield (kg ha^{-1})																			
	Kharif 2013					Kharif 2014					Kharif 2015					Pooled				
	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
M_1	1495	1646	1540	1756	1609	1758	1795	1520	1873	1736	1250	2228	1534	2005	1754	1501	1890	1531	1878	1700
M_2	1813	2510	2215	2261	2200	1879	3005	1907	2339	2283	1590	2581	1824	2205	2050	1761	2699	1982	2268	2177
M_3	2381	2435	2118	2443	2344	2466	3273	2815	2747	2825	1692	2819	2394	2420	2331	2180	2842	2442	2537	2500
Mean	1896	2197	1958	2153	2051	2034	2691	2080	2320	2281	1511	2543	1917	2210	2045	1814	2477	1985	2228	2126
Comp means of	S.Em ±		CD (0.05)			S.Em ±		CD (0.05)			S.Em ±		CD (0.05)			S.Em ±		CD (0.05)		
Main plot (L)	47		162			78		270			63		219			37		110		
Sub-plot (M)	53		160			58		174			46		139			30		87		
L X M	107		NS			116		347			93		NS			61		173		
CV (L, M)	6.9		9.0			10.3		8.8			9.3		7.9			9.0		8.6		

Table 1.2 : Interaction effect between land configuration and mulching on kernel yield (kg ha^{-1}) of groundnut *Kharif* 2013, 2014, 2015 and pooled).

Treatments	Kernel yield (kg ha^{-1})																			
	Kharif 2013					Kharif 2014					Kharif 2015					Pooled				
	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
M_1	1068	1178	1096	1248	1148	1243	1298	1054	1311	1227	868	1650	1072	1425	1254	1060	1376	1074	1328	1209
M_2	1359	1876	1635	1681	1638	1334	2183	1340	1645	1626	1136	1819	1305	1549	1452	1276	1959	1426	1625	1572
M_3	1741	1738	1515	1744	1685	1764	2394	2004	1971	2033	1202	2036	1674	1705	1654	1569	2056	1731	1807	1791
Mean	1389	1597	1415	1558	1490	1447	1959	1466	1642	1628	1069	1835	1350	1559	1453	1302	1797	1410	1586	1524
Comp means of	S.Em ±		CD (0.05)			S.Em ±		CD (0.05)			S.Em ±		CD (0.05)			S.Em ±		CD (0.05)		
Main plot (L)	33		114			58		201			39		135			26		77		
Sub-plot (M)	39		117			42		127			36		108			23		64		
L X M	78		NS			85		254			72		NS			45		129		
CV (L, M)	6.6		9.1			10.7		9.0			8.0		8.6			8.8		8.9		

Table 1.3 : Interaction effect between land configuration and mulching on haulm yield (kg ha^{-1}) of groundnut (*Kharif* 2013, 2014, 2015 and pooled).

Treatments	Haulm yield (kg ha^{-1})																			
	Kharif 2013					Kharif 2014					Kharif 2015					Pooled				
	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
M_1	2044	2540	2745	2733	2516	2399	1948	1820	2228	2099	1725	2867	2466	2647	2426	2056	2452	2344	2536	2347
M_2	2581	3292	2810	2942	2906	2594	2700	2770	2553	2654	2161	3031	2300	2847	2585	2445	3008	2627	2781	2715
M_3	3002	2977	2702	2761	2860	2995	4011	2920	3478	3351	2247	3413	2666	2960	2821	2748	3467	2762	3066	3011
Mean	2542	2936	2752	2812	2761	2663	2887	2503	2753	2701	2044	3104	2477	2818	2611	2416	2976	2578	2794	2691
Comp means of	S.Em ±		CD (0.05)			S.Em ±		CD (0.05)			S.Em ±		CD (0.05)			S.Em ±		CD (0.05)		
Main plot (L)	94		NS			113		NS			67		231			54		160		
Sub-plot (M)	82		247			66		199			65		195			41		118		
L X M	165		NS			133		398			130		NS			83		236		
CV (L, M)	10.2		10.4			12.6		8.5			7.7		8.6			10.4		9.2		

Symbols : L_1: Conventional method; L_2: Broad bed and furrow method; L_3: Ridge and furrow method; L_4: Raised bed and furrow (30 cm width with 30 cm furrow); M_1: Mulching Control; M_2: Organic mulch i.e. Paddy straw mulch; M_3: Transparent polythene mulch

Table 2 : Economics of groundnut as influenced by different treatments (Pooled data of 3 years)

Treatments	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B : C ratio
A) Land configuration				
L_1 : Conventional method	72621	78926	6305	1.09
L_2 : Broad bed and furrow method	77209	108601	31392	1.41
L_3 : Ridge and furrow method	76906	86667	9762	1.13
L_4: Raised bed and furrow (30 cm width with 30 cm furrow)	74417	97256	22838	1.31
B) Mulching				
M_1 : Control	65866	74652	8786	1.14
M_2 : Organic mulch i.e. Paddy straw mulch	77129	94726	17597	1.23
M_3 : Transparent polythene mulch	82870	109211	26341	1.32

Produce and input Rates :

Kharif seasons	Groundnut pod (Rs. kg^{-1})	Haulm (Rs kg^{-1})	Labour (Rs. day^{-1})	N (Rs kg^{-1})	P_2O_5 (Rs kg^{-1})	FYM (Rs tone^{-1})	Gr.nut Seed (Pod) (Rs. kg^{-1})	Paddy Straw mulch (Rs. kg^{-1})	Mulch paper (Rs. kg^{-1})	Land configuration	Polythene mulch required (kg ha^{-1})	Paddy straw required (kg ha^{-1})
2013	35.0	1.5	120.0	12.2	37.5	1000.0	63.0	1.5	160	L_1	55.00	5000
2014	45.0	1.5	180.0	12.2	37.5	1000.0	63.0	1.5	160	L_2	44.00	4000
2015	45.0	1.5	180.0	12.2	37.5	1000.0	63.0	1.5	160	L_3	55.00	5000
										L_4	27.50	2500

Yield **:** The dry pod yield of groundnut cultivar TKG Bold was significantly highest (2477 kg ha^{-1}) under the treatment broad bed and furrow sowing over all other land configurations. The increment in dry pod yield due to sowing on broad bed and furrow over conventional sowing was to the tune of 26.77 %. The same trend was followed for the kernel and haulm yield of groundnut cultivar TKG Bold. Sowing on conventional method recorded the lowest pod, kernel and haulm yield than other land configurations. Broad Bed and Furrow provided the loose soil mass with adequate soil moisture by retaining soil moisture. This situation is congenial for easy peg penetration, pod development and thereby the shelling percentage, thus enabling the plants to express their potential to large extent, which was reflected in increasing the dry pod yield and subsequently kernel and haulm yield of groundnut. These results are in hormone with the findings of Patil (1991), Desai and Kenjale (1992), Kadam (1998), Pawar (2000), Ingole *et al*. (2000) and Sonwalkar (2005). Venkateshwarlu (1986) reported that broad bed and furrows are site specific and gave a yield advantage of about 20 + 5% over the flat bed method owing to increased moisture retention for extended times. Similarly, the on-farm trials conducted by Legoften unit of ICRISAT (1991) reported that better performance of groundnut grown on the broad bed and furrow system of planting (BBF) were observed than those grown on flat land. Pawar *et al*. (2000) and they reported that, pod yield increase of 7.5 per cent under broad bed and furrow method than that of flat beds. The environmental conditions in respect of soil-water- plant relationship largely influenced the pod formation and development in broad bed furrow, which also provided loose soil mass, adequate soil moisture and air tends to increased yield.

Effect of Mulching

Ancillary and yield attributes : There was significant difference observed for plant height, number of pods $plant^{-1}$, 100 kernel weight and shelling per cent of groundnut due to different mulching treatments under study. Groundnut sowing with transparent polythene mulch noticed significantly higher plant height, number of pods $plant^{-1}$ and 100 kernel weight over no mulch (control) but was at par to sowing with paddy straw mulching. Moreover, shelling percentage was significantly higher in paddy straw mulch treatment over control (no mulch) and at par with polythene mulching (Table 1). Zagade and Chavan, (2006) reported that, polythene mulch produced significantly higher values of the growth attributing characters such as plant height, number of leaves, branches and dry matter accumulation $plant^{-1}$ and yield attributing characters like number and weight of mature pods and number of kernels pod^{-1}, 100 kernel weight, shelling percentage, dry pod and haulm yield ha^{-1} over without mulch treatment.

Yield : The groundnut sowing with transparent polythene mulch recorded significantly the highest pod, kernel and haulm yield (2500, 1791 and 3011 kg ha^{-1}, respectively) over sowing with paddy straw and no mulch (control) treatment. Increase in dry pod yield due to use of transparent polythene mulch was to the magnitude of 12.92 % and 32.0% over paddy straw mulch and no mulch (control), respectively. The exploitation of mulching tends to significant increment in pod yield of groundnut (Table 1). The higher yield of groundnut with use of mulch was attributed due to conservation of soil moisture and regulation of soil temperature by mulching, which led to production of higher yield attributes and ultimately reflected in higher pod yield (Cheong *et al*. 1995 and Sanjeev *et al*. 2016). This might be due to the beneficial effect of polythene mulch in terms of higher soil temperature and water which might have resulted into better root growth, microbial activities, nutrient availability and hence better growth and yield performance of groundnut crop under polythene mulch over without mulching.

Economics

The effect of land configuration on economic of the land configuration on productivity and resource use efficiency of *kharif* groundnut is presented in Table 2 revealed that, groundnut sowing on Broad Bed and Furrow method remained topped, in rank for net returns (₹ 31,392 ha^{-1}) and B:C ratio of 1:1.41, which was followed by groundnut sowing on raised bed and furrow (₹ 22,838 ha^{-1} and 1:1.31 B:C ratio, respectively).

The economic of the treatments indicated that, use of polythene mulch for groundnut sowing noticed higher net returns of ₹ 26,341 ha^{-1} with B:C ratio of 1: 1.32 and this was followed by groundnut sowing with paddy straw mulch (₹ 17,597 ha^{-1} and 1:1.23 B:C ratio, respectively) (Table 2).

Interaction effect

The interaction effects between land configuration and mulching was found to be significant for dry pod, kernel and haulm yield of groundnut. Groundnut sowing on broad bed and furrows (80-20 cm) with transparent polythene mulch (L_2M_3) recorded significantly higher dry pod, kernel and haulm yield (2842, 2056 and 3467 kg ha^{-1}, respectively) over rest of all other treatment combinations but was at par with broad bed and furrow sowing with paddy straw mulch application i.e. L_2M_2 treatment combination for pod and kernel yield (2699 and 1959 kg ha^{-1}, respectively) of groundnut.

Conclusion

It was concluded from the present investigation that, higher productivity and profitability from *kharif* groundnut was obtained by sowing groundnut on broad bed and furrow (80-20 cm) with transparent polythene mulch under lateritic soils of *Konkan*.

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