



Enhancing Productivity, Nutrient Uptake And Economics Of Different Cropping Systems

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ABSTRACT

A field experiment was carried out during 2011-12 and 2012-13 at MPKV, Rahuri (M.S.), to study the productivity, nutrient uptake and economics of groundnut based cropping systems under different nutrient management treatments. The treatment consists of three cropping systems [groundnut (*Arachis hypogaea* L.)-onion (*Allium cepa* L), groundnut-wheat [*Triticum aestivum* (L) emend. Fiori & Paol.] and groundnut-chickpea (*Cicer arietinum* L.)] with four nutrient management treatments viz., recommended dose of fertilizer, fertilizer dose as per soil test, fertilizer dose as per STCR equations and control as main plot treatments whereas three fertilizer levels viz., 100 % RDF, 75% RDF and 50 % RDF as sub plot treatments. Among the cropping systems, groundnut-onion cropping system recorded significantly maximum total system productivity (67.21 and 89.17 q/ha), production efficiency (30.16 and 39.96 kg/ha/day) and economic efficiency (Rs. 620.66 and 1064.26 /ha/day) than rest of the cropping systems. Secondly, groundnut-chickpea cropping system registered significantly higher total system productivity as compared to groundnut-wheat and also recorded higher nutrient uptake of nitrogen (215.64 and 221.64 kg ha⁻¹) during both years. Similarly, groundnut- onion cropping system obtained significantly maximum gross monetary returns (Rs.2,31, 903 and Rs. 3,34, 409 /ha), net monetary returns (Rs.1,38,207 and Rs. 2,37,982 /ha) and B:C ratio (2.84 and 3.47) than rest of cropping systems.

Key words: Cropping systems, System productivity, Nutrient uptake, & Economics

Received 19.01.2019

Revised 20.02.2019

Accepted 24.02.2019

INTRODUCTION

Groundnut is a very important leguminous oilseed crop with high nutritive value of its kernels, containing 43.6 % edible oil and 25.3 % protein [1]. The oilseeds occupy a significant place in national economy next to food grains. But the productivity of oilseeds (995 kg/ ha) is still far below the World average (1632 kg/ ha). The main reason being that oilseeds are cultivated largely under energy starved conditions. The challenge of producing 58.56 million tonnes of oilseeds to meet the requirement of 1.13 billion Indian populations. A gap of about 33.82 million tonnes of oilseeds needs the growth rate of 5.56 per cent per annum in the production. Area under oilseeds is not likely to increase in the near future. Continuous cropping of cereal-cereal crop sequence over a long period of time reduces productivity and soil fertility. The stagnation in system productivity, reduction in profitability and decline in soil health has been experienced. Inclusion of groundnut crop in a sequence not only takes care of soil health but also gives higher yield and helps to increase soil organic carbon, available N, P and K fertilizer in 0-15 cm soil layer. In nutrient management, the targeted yield concept has proved to be superior to others whose theoretical basis and proof was demonstrated by[4]. To increase the production and profitability of legume based cropping system on effort has been made to carry out an experiment for two consecutive years with "productivity, nutrient uptake and economics of groundnut based diversified cropping systems".

MATERIAL AND METHODS

A field experiment was carried out during 2011-12 and 2012-13 at MPKV, Rahuri (M.S.) on sandy clay loam soil with low in available nitrogen (172.11 kg /ha), medium in available phosphorus (18.02 kg /ha) and high in available potassium (427.0 kg /ha) and moderate in Fe (6.89 µg/g soil), Mn (9.51 µg/g soil), Zn (0.62µg/g soil) and Cu (3.41 µg/g soil). The soil was moderately alkaline in reaction (pH 8.2). The electrical conductivity, organic carbon and CaCO₃ were 0.29 dS/m, 0.54 and 4.50 per cent, respectively.

The treatment consist of three cropping systems *viz.*, C₁-groundnut-onion, C₂-groundnut-wheat and C₃-groundnut-chickpea with four nutrient management treatments *viz.*, T₁- recommended dose of fertilizer, T₂-fertilizer dose as per soil test, T₃- fertilizer dose as per STCR equations and T₄- control as main plot treatment whereas three fertilizer levels *viz.*, F₁-100 % RDF, F₂-75% RDF and F₃- 50 % RDF as sub plot treatments. The experiment was laid out in a strip plot design with three replications. Groundnut JL- 501, onion N 2-4-1, wheat- Trimbak and chickpea-Digvijay these cultivators were used during *kharif* and *rabi* seasons, respectively. Both the year's crop seasons were favorable to grow the *kharif* and *rabi* crops. The recommended package of practices were adopted to grow the crops and fertilizers were applied as per treatments.

RESULT AND DISCUSSION

Total system productivity

The total system productivity of cropping systems was assessed based on groundnut equivalent yield in groundnut-onion, groundnut-wheat and groundnut-chickpea cropping systems. Among the cropping systems, groundnut-onion cropping system recorded significantly maximum total system productivity of 67.21, 89.17 and 78.19 q/ ha and it was 115.48 and 160.12 per cent higher than groundnut-wheat and 68.19 and 116.43 per cent higher than groundnut-chickpea during first year and second year (Table 1).

The nutrient management as per STCR equation proved it's superiority by recording maximum total system productivity of 60.91 and 72.86 q/ha and it was 17.38 and 15.11 per cent higher than recommended dose of fertilizers during both years. The secondly nutrient management of as per soil test was recorded 53.74 and 64.92 q/ha. The lowest system productivity was recorded by control treatment during both years.

The total system productivity was significantly higher with 100 per cent recommended dose of fertilizer to succeeding crop during *rabi* season than 50 per cent recommended dose of fertilizer and at par with 75 per cent recommended dose of fertilizer during both the years (Table 1). These results are in accordance with [5] and [3]

Production efficiency

Among the cropping systems, groundnut-onion cropping system registered significantly higher production efficiency (30.16 and 39.96 kg/ha/day) than groundnut-wheat and groundnut-chickpea cropping systems during both the years of experimentation. The groundnut-wheat cropping system registered significantly lowest on production efficiency (14.34 and 15.67 kg/ha/day) during both the years.

The nutrient management treatments as per STCR equation registered significantly higher production efficiency of 27.63 and 32.87 kg /ha/day and it was 19.24 and 15.53 per cent higher than recommended dose of fertilizer during first year and second year.

Application of 100 per cent recommended dose of fertilizer to succeeding crop during *rabi* season registered significantly higher production efficiency (21.84 and 26.40 kg /ha /day) than 50 per cent recommended dose of fertilizer and at par with 75 per cent recommended dose of fertilizer during both the years (Table 1). Similar findings were postulated by [7] and [9]

Economic efficiency

The groundnut-onion cropping system recorded significantly higher economic efficiency (Rs.620.66 and 1064.26 /ha/day) than groundnut-wheat (Rs.166.09 and 252.63 /ha/day) and groundnut-chickpea (Rs. 327.32 and 399.66 /ha/day) cropping systems during both the years. Application of fertilizer as per

STCR equation to *kharif* groundnut recorded significantly higher economic efficiency (Rs. 578.11 and 848.56 /ha/days) than rest of the nutrient management and control treatment during both the years. The control treatment registered significantly lowest economic efficiency (Rs. 9.74 and 36.72 /ha /day) during both the years.

Application of 100 per cent recommended dose of fertilizer to succeeding crop during *rabi* season recorded significantly higher economic efficiency (Rs. 391.75 and 607.80 /ha/day) than 50 per cent recommended dose of fertilizer level (Rs. 335.41 and 511.04 /ha/day) and it was at par with 75 per cent recommended dose of fertilizer (Rs. 386.92 and 597.72 /ha/day) during both years (Table 1). These results are in agreement with Walia *et al.* (2009) and Singh *et al.* (2012).

Nutrient uptake

Among the cropping systems, the higher uptake of nitrogen was recorded by groundnut- chickpea cropping system (215.64 and 221.61 kg ha⁻¹) during both years. The groundnut and chickpea are legumes which requires higher amount of nitrogen for their metabolic activities. Similarly, groundnut- wheat cropping system recorded significantly higher uptake of phosphorus (35.91 and 35.0) and potassium (167.14 and 171.25 kg ha⁻¹) during 2011-12 and 2012-13.

In nutrient management studies, the residual effect of STCR yield target equations recorded higher yield and its ultimately effects to uptake of nutrients viz., Nitrogen (237.35 and 243.04 kg ha⁻¹), phosphorus (47.98 and 45.46 kg ha⁻¹) and potassium (167.55 and 170.92 kg ha⁻¹).

Table 1. The productivity of different cropping systems as influenced by different treatments.

Treatment	Total system productivity (q/ ha)		Production efficiency (kg/ ha/day)		Economic efficiency (Rs. ha/day)		Nutrients uptake (kg/ ha)					
							Nitrogen		Phosphorus		Potassium	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
A. Cropping system (C)	67.21	89.17	30.16	39.96	620.66	1064.26	146.84	142.01	34.35	31.45	97.43	95.12
C ₁ - Groundnut-onion	31.19	34.28	14.34	15.67	166.09	252.63	171.60	178.75	35.91	35.00	167.14	171.25
C ₂ - Groundnut-wheat	39.96	41.20	18.94	19.61	327.32	399.66	215.64	221.61	33.02	31.82	122.16	126.14
C ₃ - Groundnut-chickpea	0.39	0.56	0.18	0.26	6.68	9.66	3.80	3.86	0.81	0.84	3.62	3.52
SEm ±	1.14	1.66	0.53	0.75	20.13	28.35	11.41	12.11	2.41	2.52	10.82	10.56
CD at 5%												
B. Nutrient management (T)												
T ₁ - Recommended dose of fertilizer	50.32	61.85	23.17	28.45	422.98	681.73	188.37	196.14	35.33	35.07	137.88	144.02
T ₂ -Fertilizer dose as per soil test	53.74	64.92	24.60	9.44	474.61	721.74	206.42	215.08	39.89	38.78	148.34	153.48
T ₃ - Fertilizer dose as per STCR eq ⁿ	53.74	64.92	24.60	9.44	578.11	848.56	237.35	243.04	47.98	45.46	167.55	170.92
T ₄ -Control (No Fertilizers)	60.91	72.86	27.63	0.29	9.74	36.72	79.97	68.91	14.49	11.71	61.86	54.93
SEm ±	19.53	19.91	9.18	0.87	23.25	32.73	13.22	13.53	2.43	2.61	12.61	11.53
C.D. at 5%	0.45	0.65	0.21	0.87								
	1.32	1.92	0.61									
C. Fertilizer levels (F)												
F ₁ - 100% of RDF	47.68	57.18	21.84	26.40	391.75	607.80	190.28	195.81	36.76	36.69	137.03	139.65
F ₂ - 75% of RDF	47.12	56.40	21.61	25.49	386.92	597.72	182.11	186.62	34.96	33.23	130.82	134.07
F ₃ - 50% of RDF	43.58	51.07	19.99	23.34	335.41	511.04	161.70	159.95	31.54	28.26	118.87	118.79
SEm ±	0.44	0.33	0.20	0.32	6.94	5.65	3.46	4.22	0.91	0.97	2.89	2.93
C.D. at 5%	1.25	0.94	0.57	0.95	19.76	16.08	10.25	12.61	2.73	2.72	8.71	8.94
General Mean	46.13	54.88	21.15	25.08	371.36	572.18	178.03	180.79	34.42	32.74	128.91	130.84

The fertilizer levels viz., 100, 75 and 50 per cent of recommended dose of fertilizer showed a significant difference. Application of fertilizer dose of 100 per cent recommended dose of fertilizer recorded significantly higher nutrient uptake than 50 per cent and at par with 75 per cent recommended dose of fertilizer. Similar findings were reported by [8]

Interaction

The interaction effect between cropping systems and nutrient management, nutrient management and fertilizer levels and cropping systems and fertilizer levels were found significant during both years in respect of yield, total system productivity and energy studies.

Economics

Among the cropping systems, groundnut- onion cropping system obtained significantly maximum gross monetary returns (Rs. 2, 31,903 and Rs. 3,34,409 /ha), net monetary returns (Rs. 1,38,207 and Rs. 2,37,982/ ha) and B:C ratio (2.48 and 3.47) than groundnut-wheat and groundnut-chickpea cropping systems during both the years.

The groundnut-chickpea cropping system was found second rank in respect of gross and net monetary returns during both the years. Application of fertilizer as per STCR equation to *kharif* groundnut obtained significantly maximum gross monetary returns (Rs. 2,10,156 and Rs. 2,73,232 /ha), net monetary returns

(Rs. 1,27,665 and Rs. 1,88,477 /ha) and B:C ratio (2.58 and 3.22) than rest of the nutrient management treatments during both the years.

Application of 100 per cent recommended dose of fertilizer to succeeding crop during *rabi* season obtained significantly maximum gross monetary returns (Rs.1,64,493 and Rs. 2,14,458), net monetary returns (Rs. 86,092 and Rs.1,33,688 /ha) and B:C ratio (2.10 and 2.65) than 50 per cent recommended dose of fertilizer. However, it was at par with 75 per cent recommended dose of fertilizer in respect of gross monetary returns, net monetary returns and B: C ratio during both the years (Table 2). Similar findings have been reported by [9][2] and [3] .On the basis of two years of experiment, it could be stated that, among the cropping systems, groundnut-onion cropping system was found most beneficial to achieve maximum productivity and profitability with application of fertilizer as per STCR equation to *khari* groundnut followed by 75 per cent recommended dose of fertilizer (75:37.5:37.5 N, P₂O₅, K₂O kg /ha) to onion during *rabi* season.

Table 2: Economics of different cropping systems as influenced by different treatments.

Treatment	Gross monetary returns (Rs. / ha)		Cost of cultivation (Rs. / ha)		Net monetary returns (Rs. / ha)		B:C ratio	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
A. Cropping system (C)								
C ₁ - Groundnut-onion	231903	334409	93696	96426	138207	237982	2.48	3.47
C ₂ - Groundnut-wheat	107622	128550	71156	72993	36465	55557	1.51	1.76
C ₃ - Groundnut-chickpea	137887	154535	67769	70252	70118	84282	2.05	2.16
SE m ±	1349	2130	---	---	1349	2129	---	---
CD at 5%	3960	6248	---	---	3958	6247	---	---
B. Nutrient management (T)								
T ₁ - Recommended dose of fertilizer	173601	231969	81112	83369	92490	148599	2.14	2.78
T ₂ -Fertilizer dose as per soil test	185431	243449	81223	84489	104208	158959	2.29	2.88
T ₃ - Fertilizer dose as per STCR eq ⁿ (25 q /ha)	210156	273232	82491	84754	127665	188477	2.58	3.22
T ₄ -Control (No fertilizers)	67361	74675	---	---	1558	2458	---	---
SE m ±	1558	2459	---	---	4570	7213	---	---
C.D. at 5%	4573	7215	---	---	---	---	---	---
C. Fertilizer levels (F)								
F ₁ - 100% of RDF	164493	214458	78401	80769	86092	133688	2.10	2.65
F ₂ - 75% of RDF	162564	211504	77540	79890	85023	131614	2.09	2.64
F ₃ - 50% of RDF	150355	191531	76680	79011	73674	112519	1.96	2.42
SE m ±	1519	1241	---	---	1519	2198	---	---
C.D. at 5%	4322	3530	---	---	4322	6594	---	---
General Mean	159137	205831	77540	79890	81597	125940	2.05	2.57

Market price: 2011-12: Groundnut 3450 Rs. / q, Onion 360 Rs. / q, Wheat 1400 Rs. / q, Chickpea 3300 Rs. / q
2012-13: Groundnut 3750 Rs. / q, Onion 600 Rs. / q, Wheat 1800 Rs. / q, Chickpea 3600 Rs. / q

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CITATION OF THIS ARTICLE

D. P. Pacharne, N. J. Danawale, A. K. Kolage and P. H. Deshmukh . Enhancing productivity, nutrient uptake and economics of different cropping systems . Bull. Env. Pharmacol. Life Sci., Vol 8 [6] May 2019: 136-140