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## Response of profitability of soybean based cropping sequence to different nutrient management levels

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### Abstract

The present experiment entitled “Response of profitability of soybean based cropping sequence to different nutrient management levels” was conducted during 2017-18 and 2018-19 at Agronomy Farm, PDKV Akola (MS). The soybean-based crop sequences were assessed on the basis of gross, net returns and benefit to cost ratio. Among the cropping sequence, significantly maximum gross monetary returns (3.63, 3.88 and 3.75 Rs. lakh ha<sup>-1</sup>), net monetary returns (2.56, 2.79 and 2.68 Rs. lakh ha<sup>-1</sup>) and benefit to cost ratio (3.40, 3.56 and 3.48 Rs. lakh ha<sup>-1</sup>) were realized from soybean-onion cropping sequence as compare to soybean-potato cropping sequence during first year, second year and pooled mean, respectively.

Among nutrient management to soybean (*kharif*), application of 100% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer to soybean recorded significantly higher gross monetary returns (3.64, 3.87 and 3.75 Rs. lakh ha<sup>-1</sup>), net monetary returns (2.55, 2.75 and 2.65 Rs. lakh ha<sup>-1</sup>) than application of 50% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer to soybean and 75% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer to soybean in first year and second year. Among the fertilizer levels to onion and potato (*rabi* crops), the *rabi* crops supplied with 125% RDF level during *rabi* season registered significantly higher gross monetary returns (3.68, 3.93 and 3.81 Rs. lakh ha<sup>-1</sup>) than 100% RDF and 75% RDF levels in first year and second year and on pooled mean basis. The *rabi* crops supplied with 125% RDF level during *rabi* season registered significantly higher net monetary returns (2.59, 2.81 and 2.70 Rs. lakh ha<sup>-1</sup>) than 100% RDF and 75% RDF levels in first year and second year. However, application of 125% RDF and 100% RDF both remained at par and recorded significantly higher net monetary returns as compared to application of 75% RDF on pooled mean basis. The benefit to cost ratio was highest with application of 125% RDF crop in both years and on pooled mean basis.

**Keywords:** Nutrient management levels, fertilizer levels, productivity, agricultural productivity, economics, research, legume, nutrition, soybean-based cropping sequence, soybean, onion, potato, food, sustainable agriculture

### Introduction

Soybean (*Glycine max.* L.) is one of the important oilseed as well as leguminous crop. Soybean as a miracle “Golden bean” of the 21<sup>st</sup> century mainly due to its high protein (40%) and oil (20%) content. In India it is mainly grown as oilseed crop. Soybean (*Glycine max* L.) is known as sojabean, soybean, Chinese pea and Manchurian bean which belongs to family Leguminosae and has eastern Asian origin. Onion (*Allium cepa* L.) is one of the most important commercial vegetables. It is grown in western, northern as well as in southern India. It is extensively cultivated throughout India for its high nutritional and medicinal properties. It is a maligned vegetable and is widely used as salad, cooked in curries, boiled, fried, baked and pickled.

Potato (*Solanum tuberosum* L.) is one of the most important non-cereal food crops in the world after wheat, rice and maize. It provides a source of low cost energy to the human diet. It is rich in starch, vitamin especially vitamin C, B<sub>1</sub> and minerals. Potato contributes to world food basket just after rice, wheat and maize. It contains 20.6 per cent carbohydrates, 2.1 per cent protein, 0.3 per cent fat, 1.1 per cent crude fibre and 0.9 per cent ash. It also contains good amount of essential amino acids like leucine, tryptophane and isoleucine.

Constraint analyses have revealed that imbalanced nutrition management is important reasons for restricted growth and declined productivity. (Tiwari *et al.*, 2002) [5]. In era of climate change maintaining yield up to required level is a challenge in coming future. Soil although being rich in nutrients but unfortunately only a small portion of it becomes available to plants especially under semi-arid climatic conditions.

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Nutrients availability is depend up on the physical and chemical structure of soil. Hence, a balanced nutrients application is must to increase the productivity and profitability of the crops. Soybean fixes atmospheric nitrogen in soil and partially fulfills the nitrogen requirement of succeeding crops. There is a need for a suitable substitute crop or cropping systems after soybean to improve the soil fertility and productivity to maximize the profitability. Majority of farmers in Vidarbhra grow cotton, tur, soybean, sorghum, rice as a *kharif* crops and wheat, chickpea, linseed, safflower, sorghum, potato, onion, garlic as a *rabi* crop on medium soil. Intensive cropping systems with high yielding improved crop varieties require a higher amount of nutrients as the system removes large amount of nutrients from the soil pool. Chemical fertilizer increases the quantity of food produced but decreases its nutritional quality and also soil fertility over the years if used in imbalanced form (Sinha *et al.*, 2010)<sup>[3]</sup>.

However, the information about the manner in which these two crops would behave after soybean if they are grown in sequence is lacking. Soybean followed by *rabi* crops such as onion and potato are most commonly adopted cropping sequence in most parts of Maharashtra. The existing system of fertilizer application is based on the nutrient requirement of the individual crop ignoring the carry over effect of the manures or fertilizer application to the succeeding crop to a great extent.

## Materials and Methods

The present experiment entitled “Effect of nutrient management on productivity and profitability of soybean based cropping sequence” was conducted during 2017-18 and 2018-19 at research farm of Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS). The experiment was laid out in split plot design with three replications. Six combinations of two crop sequences (soybean-onion and soybean-potato) and three levels of nutrient management *viz.*, 50% RDF+ FYM 5 t ha<sup>-1</sup>+ biofertilizer (N<sub>1</sub>), 75% RDF+ FYM 5 t ha<sup>-1</sup>+ biofertilizer (N<sub>2</sub>), and 100% RDF+ FYM 5 t ha<sup>-1</sup>+ biofertilizer (N<sub>3</sub>) were the main plot treatments in *kharif* season replicated three times in randomized block design. During *rabi* season each main plot treatment of nutrient management level was split into three sub plot treatments with three levels of recommended dose of fertilizer *viz.*, 75, 100 and 125% to *rabi* season crops resulting in eighteen treatment combinations replicated three times in split plot design. The experimental soil was vertisols with a clay loam in texture, low in available nitrogen (238.34 kg ha<sup>-1</sup>), medium in available phosphorus (16.79 kg ha<sup>-1</sup>) and very high in potassium content (383.26 kg ha<sup>-1</sup>). The soil pH, EC and organic carbon were 8.1, 0.38 dSm<sup>-1</sup> and 0.50 per cent, respectively.

## Results and Discussion

### Economics

The economics in forms of gross monetary returns (GMR), net monetary returns (NMR), cost of production and benefit to cost (B:C) ratio realized during 2017-18, 2018-19 and on pooled mean basis. The data on gross and net monetary

returns of different cropping sequence are presented in Table-1. The mean gross monetary returns were (3.39, 3.62 and 3.51 Rs. lakh ha<sup>-1</sup>) and net monetary returns were (2.31, 2.51 and 3.41Rs.lakh ha<sup>-1</sup>) during first year, second year and pooled mean basis respectively.

### Cropping sequence

Among the cropping sequence, significantly maximum gross monetary returns (3.63, 3.88 and 3.75 Rs. lakh ha<sup>-1</sup>), net monetary returns (2.56, 2.79 and 2.68 Rs. lakh ha<sup>-1</sup>) and B:C ratio (3.40,3.56 and 3.48 Rs. lakh ha<sup>-1</sup>) were realized from soybean-onion cropping sequence as compare to soybean-potato cropping sequence during first year, second year and on pooled mean basis, respectively. This might be because of in soybean-onion cropping sequence, onion produced higher bulb yield and recorded maximum gross monetary returns, net monetary returns and B:C ratio. Results corroborates finding of Kumarsen *et al.* (2014)<sup>[2]</sup>.

### Nutrient management to soybean (*kharif*)

Application of 100% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer (N<sub>3</sub>) to soybean recorded significantly higher gross monetary returns (3.64, 3.87 and 3.75 Rs.lakh ha<sup>-1</sup>), net monetary returns (2.55, 2.75 and 2.65 Rs. lakh ha<sup>-1</sup>) than application of 50% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer (N<sub>1</sub>) to soybean and 75% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer (N<sub>2</sub>) to soybean in first year and second year.

However, application of 100% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer (N<sub>3</sub>) to soybean and 75% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer (N<sub>2</sub>) to soybean both being at par recorded significantly higher gross monetary returns, net monetary returns as compared to application of 50% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer (N<sub>1</sub>) on pooled basis. The B:C ratio recorded was highest with application of 100% RDF + FYM 5 t /ha + Biofertilizer (N<sub>3</sub>) to soybean crop in both years and pooled mean basis. This might be due to beneficial residual effect of preceding crop (soybean) which registered maximum yield potential of different cropping system which reflects on maximum monetary benefit as compared to lower levels to crop during both the years. Similar results were reported by Thorat (2018)<sup>[4]</sup>.

### Fertilizer levels to onion and potato (*rabi* crops)

The *rabi* crops supplied with 125% RDF Level during *rabi* season registered significantly higher gross monetary returns (3.68, 3.93 and 3.81 Rs. lakh ha<sup>-1</sup>) than 100% RDF and 75% RDF levels in first year and second year and pooled mean basis. The *rabi* crops supplied with 125% RDF level during *rabi* season registered significantly higher net monetary returns (2.59, 2.81 and 2.70 Rs. lakh ha<sup>-1</sup>) than 100% RDF and 75% RDF levels in first year and second year. However, application of 125% RDF (F<sub>3</sub>) and 100% RDF (F<sub>2</sub>) both remained at par and recorded significantly higher net monetary returns as compared to application of 75% RDF(F<sub>1</sub>) on pooled mean basis. The B:C ratio recorded was highest with application of 125% RDF(F<sub>3</sub>) crop in both years and on pooled mean basis. Similar result postulated by Gudhade (2008).

**Table 1:** Economics of soybean based crop sequence as influenced by nutrient management to soybean (*kharif*) and fertilizer levels to onion and potato (*rabi*)

Treatments	Gross monetary Return Rs. ha <sup>-1</sup> (lakh)			Cost of cultivation Rs. ha <sup>-1</sup> (lakh)			Net monetary Return Rs. ha <sup>-1</sup> (lakh)			B:C Ratio		
	2017-2018	2018-2019	Pooled Mean	2017-2018	2018-2019	Pooled mean	2017-2018	2018-2019	Pooled Mean	2017-2018	2018-2019	Pooled mean
<b>A. Cropping sequence</b>												
C <sub>1</sub> : Soybean-Onion	3.63	3.88	3.75	1.07	1.09	1.08	2.56	2.79	2.68	3.40	3.56	3.48
C <sub>2</sub> : Soybean-Potato	3.06	3.24	3.15	1.09	1.11	1.10	1.97	2.14	2.06	2.82	2.93	2.87
SE(m) <sub>±</sub>	0.07	0.07	0.09	--	--	--	0.07	0.07	0.09	--	--	--
CD at 5%	0.43	0.46	0.35	--	--	--	0.43	0.46	0.35	--	--	--
<b>B. Nutrient management to soybean (<i>kharif</i>)</b>												
N <sub>1</sub>	2.99	3.20	3.10	1.06	1.09	1.07	1.93	2.12	2.02	2.82	2.95	2.89
N <sub>2</sub>	3.41	3.62	3.52	1.08	1.10	1.09	2.33	2.53	2.43	3.17	3.29	3.23
N <sub>3</sub>	3.64	3.87	3.75	1.09	1.11	1.10	2.55	2.76	2.65	3.34	3.48	3.41
SE(m) <sub>±</sub>	0.06	0.06	0.11	--	--	--	0.06	0.06	0.11	--	--	--
CD at 5%	0.20	0.21	0.33	--	--	--	0.20	0.21	0.33	--	--	--
<b>C. Fertilizer levels to onion and potato (<i>rabi</i>)</b>												
F <sub>1</sub>	2.86	3.02	2.94	1.06	1.08	1.07	1.80	1.94	1.87	2.70	2.80	2.75
F <sub>2</sub>	3.49	3.74	3.61	1.08	1.10	1.09	2.42	2.64	2.53	3.25	3.40	3.33
F <sub>3</sub>	3.68	3.93	3.81	1.09	1.12	1.11	2.59	2.81	2.70	3.38	3.52	3.45
SE(m) <sub>±</sub>	0.05	0.05	0.06	--	--	--	0.05	0.05	0.06	--	--	--
CD at 5%	0.15	0.15	0.18	--	--	--	0.15	0.15	0.18	--	--	--
<b>Interaction</b>												
A x B	NS	NS	NS	--	--	--	NS	NS	NS	--	--	--
B x C (CD at 5%)	0.26	0.26	0.31	--	--	--	0.26	0.26	--	--	--	--
A x C	NS	NS	NS	--	--	--	NS	NS	NS	--	--	--
A x B x C	NS	NS	NS	--	--	--	NS	NS	NS	--	--	--
G. M.	3.39	3.62	3.51	1.08	1.10	1.09	2.31	2.51	2.41	3.15	3.28	3.21

**Table 2:** Gross monetary returns (GMR) as influenced by interaction between nutrient management to soybean (*kharif*) and fertilizer levels to onion and potato (*rabi*)

Nutrient management to soybean ( <i>kharif</i> )	Fertilizer levels to onion and potato ( <i>rabi</i> )								
	F1			F2			F3		
	2017-2018	2018-2019	Pooled mean	2017-2018	2018-2019	Pooled mean	2017-2018	2018-2019	Pooled mean
N1	2.36	2.52	2.44	3.35	3.60	3.47	3.26	3.51	3.39
N2	2.66	2.82	2.74	3.63	3.90	3.76	3.86	4.14	4.00
N3	3.57	3.74	3.65	3.49	3.73	3.61	3.94	4.16	4.05
B x C									
	2017-2018			2018-2019			Pooled mean		
SE (m) <sub>±</sub>	0.09			0.09			0.11		
CD at 5%	0.27			0.27			0.32		

Data for interaction presented in Table-2 revealed that the treatment combinations N<sub>3</sub>F<sub>3</sub> recorded significantly higher gross monetary returns over other treatment combinations and

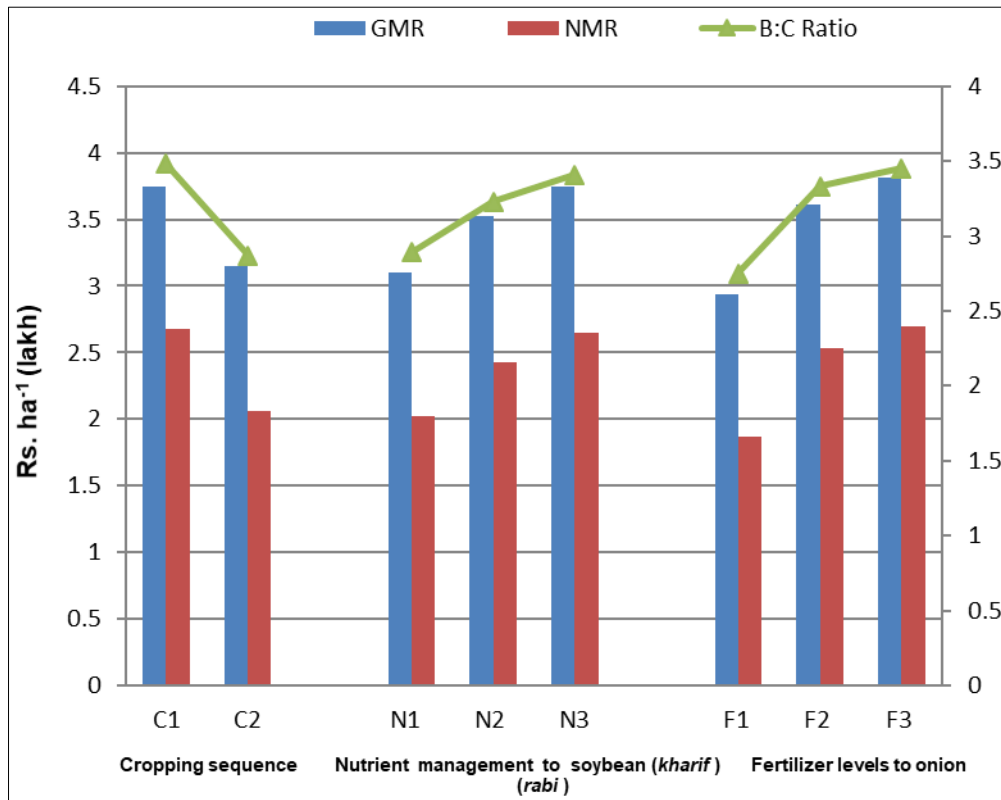
remained at par with N<sub>2</sub>F<sub>2</sub> and N<sub>2</sub>F<sub>3</sub> in both years and pooled mean basis.

**Table 3:** Net monetary returns (NMR) as influenced by interaction between nutrient management to soybean (*kharif*) and fertilizer levels to onion and potato (*rabi*)

Nutrient management to soybean ( <i>kharif</i> )	Fertilizer levels to onion and potato ( <i>rabi</i> )								
	F1			F2			F3		
	2017-2018	2018-2019	Pooled mean	2017-2018	2018-2019	Pooled mean	2017-2018	2018-2019	Pooled mean
N1	1.32	1.45	1.38	2.29	2.51	2.40	2.19	2.40	2.30
N2	1.60	1.74	1.67	2.57	2.80	2.68	2.76	3.01	2.88
N3	2.50	2.65	2.57	2.40	2.62	2.51	2.84	3.04	2.94
B x C									
	2017-2018			2018-2019			Pooled mean		
SE (m) <sub>±</sub>	0.09			0.09			0.11		
CD at 5%	0.27			0.27			0.32		

Data for interaction presented in Table-3 revealed that the treatment combinations N<sub>3</sub>F<sub>3</sub> recorded significantly higher net monetary returns over other treatment combinations and

remained at par with N<sub>2</sub>F<sub>2</sub> and N<sub>2</sub>F<sub>3</sub> in both years and pooled mean basis.



**Fig 1:** Economics of soybean based crop sequence as influenced by nutrient management to soybean (*kharif*) and fertilizer levels to onion and potato (*rabi*)

### Conclusions

From present investigation which was conducted to study the effect of nutrient management levels on economics of soybean based cropping sequence, it can be concluded that During *kharif* season, application of 100% RDF+ FYM 5 t ha<sup>-1</sup> + Bio-fertilizers to soybean recorded significantly higher gross monetary returns, net monetary returns and the B:C ratio than the other nutrient management treatments. Application 125% RDF to *rabi* crops registered significantly more gross monetary returns, net monetary returns as well as B:C ratio than application of 100% and 75% RDF to onion and potato. Among the interactions, treatment combination of 100% RDF + FYM 5 t ha<sup>-1</sup> + Biofertilizer applied to *kharif* soybean and 125% RDF to *rabi* sequence crops (onion and potato) recorded significantly higher gross monetary returns and the net monetary returns than rest of the combinations and found statistically similar with treatment combination of 75% RDF + FYM 5 t ha<sup>-1</sup>+ Biofertilizer applied to *kharif* soybean and 100% RDF to *rabi* sequence crops (onion and potato).

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