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Effect of integrated nutrient management on economics of pomegranate cv. Bhagwa under central dry zone of Karnataka

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Abstract
A field experiment was conducted in the farmer's field at Somanahalli village, Hiriyur taluk of Chitradurga district on pomegranate cv. Bhagwa during 2015-16 titled as Studies on integrated nutrient management in relation to growth and yield characters in Mrig bahar season. The experiment was laid out in randomized block design with 9 treatment combinations, comprising of inorganic, organic and biofertilizers with 3 replications. The economic analysis of crop revealed that application of 75 per cent recommended dose of fertilizers (RDF) along with vermicompost + poultry manure + *Azospirillum* + PSB + KSB (T_8) has highest net returns per unit area with excellent cost: benefit ratio of 3.45 followed by 100 per cent recommended dose of NPK in combination with vermicompost, poultry manure, *Azospirillum*, PSB and KSB has resulted with good cost: benefit ratio of 3.42 per hectare.

Keywords: Pomegranate, central dry zone, integrated nutrient management, cost, benefit ratio

Introduction
Pomegranate (*Punica granatum* L.) belongs to family Lythraceae, regarded as 'Fruit of Paradise', an ancient favorite fruit of tropical and sub-tropical regions of the world. The fruit rind, seeds and pulp comprises of rich medicinal properties. Present global pomegranate consumption ranks18th place annually and expected to move onto 10th place within the decade in view of its innumerable nutraceutical importance. The fruit rind, seeds and pulp comprises of rich medicinal properties. The fruit contains nearly about 153 phytochemicals like ellagic acid, catechin and procyanidins, fatty acids and triglycerides, sterols and terpenoids, flavonols etc. The fruit juice contains tannins, anthocyanin, polyphenols and antioxidants A, E and C which plays major role in maintenance of heart blood vessels, and proper blood circulation. The punicalagin content of juice brings down the octarial flakes of blood and there by controls the blood pressure. It also minimizes the risk of arthritis, alzheimer, cancer, piles, fistula, stomach ache, dysentery, and diarrhoea and constipation problems in human beings. Among the various factors which contribute towards the growth, yield and quality of pomegranate, nutrition is the most important and it has direct effect on production and quality. Integrated nutrient management includes, use of inorganic and organic sources of nutrients to ensure balanced nutrient proportions by enhancing nutrient response efficiency and maximizing crop productivity of desired quality. In view of this present experiment titled as "Studies on integrated nutrient management on economics of pomegranate (cv. Bhagwa) under central dry zone of Karnataka'' has been designed.

Material and Methods
The investigation conducted during 2015-16 in the farmer's field of Somanahalli village, Hiriyur taluk of Chitradurga district, titled as "Studies on integrated nutrient management in pomegranate (cv. Bhagwa) under central dry zone of Karnataka". Uniformly aged 135 plants spaced at 10 ft x10 ft were selected during Mrig bahar (June-July) of 2015. There were nine treatments along with control and each treatment was replicated thrice in a Complete Randomized Block Design. The recommended dose of fertilizers for pomegranate 400:200:200 g NPK per tree with FYM 5 tonnes per acre (12.5 tonnes per hectare 5.4 kg/ plant) was applied during the course of experimentation. Biofertilizers and organic manures were procured from KVK Babbur farm, Hiriyur. The bioferilizers like *Azospirillum*, PSB, and KSB were applied at the rate of 5 kg/ acre, (12.5 kg/ hectare, 13.61 g/ plant), poultry manure at the rate of 3.3 kg/ tree and vermicompost at 2 kg/ tree.

The recommended dose of NPK were applied in the form of urea, diammonium phosphate and muriate of potash, respectively. The growth parameters like leaf fresh and dry weight (g), leaf area (cm^2), shoot length (cm) at 30 and 60 days recorded after first bio-fertilizer application and the yield parameters like weight of fruit (g), number of fruits per plant, yield (kg/ plant), Yield per hectare (t) was recorded. The quality parameters like aril weight (g), aril per cent, seed weight (g), seed per cent, seed: aril ratio, volume of fruit (ml), diameter of fruit (cm), TSS (° Brix), reducing sugars (%), titratable acidity (%) and TSS: TA (%) was recorded. The price of all inputs prevailing at the time of their use and the labour cost were considered to work out the cost of cultivation. The integrated nutrient management of different treatment combination for economics has been worked out in pomegranate cv Bhagwa under central dry zone of Karnataka. The detailed cost of cultivation for different treatment has prevailed in (Table-4) and (Table-5).

Plate 1: General view of the experimental plot

Results and Discussion

The addition of biofertilizers like *Azospirillum*, PSB and KSB resulted in higher uptake and accumulation of nutrients in leaf tissues which in turn ensure photosynthetic efficiency causing greater synthesis, translocation and accumulation of carbohydrates. These results were similar with the earlier findings of. Sheikh and Rao (2005) [8] in pomegranate and Athani *et al*. (2005) in guava [1].

The yield attributes were significantly influenced by application of biofertilizers (Table 2). Maximum fruit weight (292.61 g) was recorded with application of 100% RDF + vermicompost + *Azospirillum* + PSB + KSB resulted the increase in fruit weight might be due to increase in cell size and intercellular space. The increase in size of fruit as a result of application of biofertilizers might be because it improved the internal physiology of developing fruit in terms of better supply of water, nutrients and other compounds vital for their proper growth and development reported by Dalal *et al.* (2004) [2] in Sapota, Sheikh and Rao (2005) in pomegranate.

The maximum fruit weight (292. 61 g), number of fruits per tree (61.00) yield per tree (17.77 kg) and yield per hectare (15.98 t) was recorded with Application of 100% RDF + vermicompost + poultry manure + *Azospirillum* + PSB + KSB (Table 2).The significant increase in fruit yield is a cumulative effect of increase in number of fruits because of reduction in fruit drop and higher fruit weight by the application of biofertilizers might have affected the physiological process resulting into higher production. These results in conformity with the findings of Dutta *et al*. (2014) Padmavathamma and Hulamani (1998) [3, 6] in pomegranate, Kulapati *et al.* (2009) [5] in banana, Patil *et al.* (2005) [1] in mango.

Thus from the present study, it may be concluded that Application of 100% RDF + vermicompost + poultry manure + *Azospirillum* + PSB + KSB is superior than the other treatments with respect to improvement in growth and important attributes contributing towards the better yield in Mrig bahar pomegranate cv. Bhagwa under central dry zone of Karnataka. However, the cost benefit ratio differed significantly due to treatments effects and also due to yield effect.

The benefit cost ratio among different treatments differed significantly (Table-2) the treatment 100% RDF + vermicompost + poultry manure + *Azospirillum* + PSB + KSB (T_9) accounted maximum net income (Rs 764296.00) which was followed by The treatment 75% RDF + vermicompost + poultry manure + *Azospirillum* + PSB + KSB (T_8) (Rs 756193.00).

The treatment 75% RDF + vermicompost + poultry manure + *Azospirillum* + PSB + KSB (T_8) had a maximum cost benefit ratio of (3.45) which was followed by 100% RDF + vermicompost + poultry manure + *Azospirillum* + PSB + KSB (T_9) (3.42), while the minimum cost benefit ratio (2.82) was recorded in 75% RDF + vermicompost + *Azo* + PSB + KSB (T_4). This might be due to reduced cost of cultivation and increased yield of pomegranate. It is worthy to note that using inorganic fertilizers at the rate of 75% recommended dose with bio-fertlizers and organic manure had a similar effect and had good benefit cost ratio (1:3.45) with that of inorganic fertilizers at the rate of 100% recommended dose with biofertilizers and organic manure.

Table 1: Effect of integrated nutrient management on cost of production per hectare of pomegranate cv. Bhagwa

Treatments	Total cost of cultivation (₹)			
	Organic manure	biofertilizers	Total	Total cost of cultivation
T_1- 100%RDF (control)	-	-	-	191707.00
T_2.-75% RDF + vermicompost	9180.00	-	9180.00	196390.00
T_3 - 75% RDF + vermicompost +*Azo*+PSB	9180.00	10098.00	19278.00	206488.00
T_4 -75% RDF + vermicompost +*Azo*+PSB+KSB	9180.00	15147.00	24327.00	211537.00
T_5 -100%RDF + poultry manure	7270.00	-	7270. 00	198977.00
T_6 -100%RDF + Poultry manure +*Azo*+PSB	7270.00	10098.00	17368.00	209075.00
T_7- 100%RDF + Poultry manure +*Azo*+PSB+KSB	7270.00	15147.00	22417.00	214124.00
T_8 -75% RDF + vermicompost + poultry manure+ *Azo*+ PSB + KSB	16450.00	15147.00	31597.00	218807.00
T_9- 100% RDF + vermicompost + poultry manure + *Azo*+ PSB + KSB	16450.00	15147.00	31597.00	223304.00

Table 2: Effect of integrated nutrient management on economics of pomegranate cv. Bhagwa

Treatment	Total cost of cultivation (₹)	Fruit yield (t/ha)	Gross income (₹)	Net income (₹)	Benefit: cost ratio
T_1-100%RDF (control)	191707.00	12.68	760800	569093.00	2.96
T_2-75% RDF + vermicompost	196390.00	13.20	792000	595610.00	3.03
T_3-75% RDF + vermicompost + *Azo* + PSB	206488.00	13.32	799200	592712.00	2.87
T_4-75% RDF + vermicompost + *Azo* + PSB + KSB	211537.00	13.49	809400	597863.00	2.82
T_5-100%RDF + poultry manure	198977.00	13.31	798600	599623.00	3.01
T_6-100%RDF + poultry manure + *Azo* + PSB	209075.00	13.64	818400	609325.00	2.91
T_7-100%RDF + poultry manure + *Azo* + PSB + KSB	214124.00	13.93	835800	621676.00	2.90
T_8-75% RDF + vermicompost + Poultry manure + *Azo* + PSB + KSB	218807.00	16.25	975000	756193.00	3.45
T_9-100% RDF+ vermicompost + Poultry manure + *Azo* + PSB + KSB	223304.00	16.46	987600	764296.00	3.42

Table 3: Effect of integrated nutrient management on yield attributes of pomegranate cv. Bhagwa

Treatment	Number of fruits per plant	Fruit weight (g)	Yield per plant (kg)	Yield per hectare (tonnes)
T_1-100%RDF (control)	56.06	245.85	13.82	12.68
T_2-75% RDF + vermicompost	57.06	251.82	14.38	13.20
T_3-75% RDF + vermicompost + *Azo* + PSB	57.22	253.63	14.51	13.32
T_4-75% RDF + vermicompost + *Azo* + PSB + KSB	57.82	254.05	14.69	13.49
T_5-100%RDF + poultry manure	57.00	254.25	14.50	13.31
T_6-100%RDF + poultry manure + *Azo* + PSB	56.83	260.50	14.86	13.64
T_7-100%RDF + poultry manure + *Azo*+ PSB+ KSB	56.98	266.28	15.17	13.93
T_8-75% RDF + vermicompost + poultry manure + *Azo*+ PSB + KSB	60.87	290.87	17.70	16.25
T_9-100% RDF + vermicompost+ poultry manure + *Azo* + PSB + KSB	61.22	292.67	17.93	16.46
S. Em.±	0.29	2.09	0.10	0.61
C.D. at 5%	0.87	6.26	0.31	1.83

Table 4: cost of cultivation for pomegranate cv. Bhagwa

Sl. No.	Materials/works	Pomegranate Hectare (918 pl.)
I.	**Inputs**	
1	Fertilizers (400: 200: 200 g NPK/plant)	
	a. Urea @ ₹6.25/kg	4000
	b. DAP @ ₹22/kg	8778
	c. MOP @ ₹ 16.88/kg	5145
2	FYM – 12.5 tonnes 1000 ₹ /tonne	12500
3	Plant protection chemicals	20400
4	Plant protection equipments cost	5100
II	**Labour charges**	
1	Cost and spraying of micronutrients -20 labours @ 183.6 Rs/ labour	3672
2	Irrigation, watch and ward	71400
3	Weeding and fertilizer application -15 labours @ 183.6 Rs/ labour	2754
4	Training and pruning - 15 labours @ 1800 Rs/ labour	27000
5	Plant protection measures - 25 labours @ 180 Rs/ labour	4500
6	Harvesting-33 labours @ 183.57 Rs/ labour	6058
III.	**Other expenses**	
1	Misc. expenses (Land rent and others)	20400
	Total (Rs.)	191707.00

Note: Price of pomegranate/ Marketable price @ ₹ 60/kg.

Table 5: Cost of Organic manures and Biofertilizers

Sl. No.	Components	Amount (₹)
Organic manures		
1	Vermicompost	5.00/kg
2	Poultry manure	2.00/kg
Biofertilizers		
1	*Azospirillum*	110.00/kg
2	Phosphate Solubilizing Bacteria (PSB)	110.00/kg
3	Potassium Solubilizing Bacteria (KSB)	110.00/kg

Conclusion

Based on the findings of the research, it is possible to conclude that application of 75% Recommended dose of fertilizer with biofertilizers and organic manure had good benefit cost ratio and we can save 25% fertilizer compared to 100% Recommended dose of fertilizers.

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