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Effect of Fertilizer Levels on Growth and Economics of Nutmeg (*Myristicafragrans* Houtt)

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ABSTRACT: *A field experiment was conducted at the Department of Spices and Plantation Crops at Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2011-2013. The experiment was laid out in a randomized block design using ten treatments with three replications. Different levels of fertilizer doses viz., 75, 100 and 125% and recommended N, P and K through drip fertigation along with micronutrients. In the control Plot, the recommended dose of NPK was applied to soil with furrow irrigation. The results revealed that tree height(4.75cm and 4.88cm) trunk girth(63.26cm and 69.12cm) specific leaf weight(4.12gcm^{-2} and 4.09 gcm^{-2}) gross return (729144 ha^{-1}, 744120 ha^{-1}) and net return (607377 ha^{-1}, 622353 ha^{-1}) benefit: cost ratio (5.98: 6.11) were higher under the fertigation treatment with 100% water soluble fertilizer along with micronutrients during 2011 and 2012 respectively.*

Key words: *Nutmeg, Growth, Economics, Fertilizer levels*

INTRODUCTION

Nutmeg is an important tree spice belongs to the family Myristicaceae. It is a native of Indonesia and distributed in areas of West Indies, Sri Lanka, India, Phillipines, Tropical America and Pacific islands (Verghese, 2000). In India, nutmeg is grown in some parts of Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, North East India and Andaman (Krishnamoorthy, 2000). In Kerala, nutmeg is mainly cultivated as a homestead crop in coconut and arecanut gardens. World average production of nutmeg is estimated between 10,000 and 12,000 tonnes per year, with annual world demand estimated at 9,000 tonnes. Indonesia and Grenada dominate in nutmeg production and export of nutmeg products *viz*., nutmeg seed and mace with world market share of 75 and 20 per cent respectively. Therefore, proper management of nutrients is essential to realize maximum potential of the crop and to get higher economic benefit. Nutrients are important crucial elements, which are required for the plant for its growth and development. The translocation of photosynthates from source to sink is very important for the development of economic part. Thus, there is great scope for yield improvement in nutmeg for increasing yield and quality. The optimum dose of fertilizer application not only increases the yield but also improves the quality. Dumping of huge quantity of fertilizers in the soil becomes uneconomical besides polluting the environment. Application of major nutrients in proper ratio and optimum quantity can help growers to get the maximum benefit out of these inputs. To obtain high yield and quality of nutmeg, timely application of nutrients is a pre-requisite. Fertigation allows applying the nutrients, exactly and uniformly directly to the root volume, where the plants' active roots are concentrated. This remarkably increases the efficiency of the applied fertilizers thus economizing the quantity of fertilizers and water, and the cost of labour and energy resulting in reduced cost of cultivation. Adoption of advanced and efficient methods of application of water and fertilizers will have saving upto 50% fertilizers usage. Hence, the present investigation was taken up to find out the influence of fertilizer levels on yield and economics of nutmeg.

MATERIALS AND METHODS

A field experiment was conducted at farmer field Devanur Pudhur 2011-2013 to study the influence of

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fertilizer levels on growth and economics in nutmeg under drip irrigated condition. The experiment was laid out in a randomized block design using ten treatments with three replications. Different levels of fertilizer doses viz., 75, 100 and 125% and recommended N, P and K through drip fertigation along with micronutrients. In the control plot, the recommended dose of NPK was applied to soil with furrow irrigation without micronutrients. The soil of the experimental field was sandy loam. The nutrient status of soil during the experiment was with availableNitrogen (305kg N ha^{-1}), available phosphorus (26.5 kg P ha^{-1}) and available potassium (499.6 kg K ha^{-1}). The fertigation scheduling was so planned to meet the crops demand and requirement of the nutrients at different stages of crop growth.

Treatment details

T_1 : Control: 100% RDF* as soil application without Micronutrients

T_2 : 100% RDF as soil application + Micronutrients

T_3 : 75% RDF as Conventional fertilizers + Micronutrients.

T_4 : 100% RDF as Conventional fertilizers + Micronutrients.

T_5 : 125% RDF as Conventional fertilizers + Micronutrients

T_6 : 100% RDF as Conventional fertilizers without Micronutrients.

T_7 : 75% RDF as WaterSoluble Fertilizers + Micronutrients.

T_8 : 100% RDF as WaterSoluble Fertilizers + Micronutrients.

T_9 : 125%RDF as WaterSoluble Fertilizers + Micronutrients.

T_{10} : 100% RDF as WaterSoluble Fertilizers without Micronutrients

*Recommended dose of fertilizers for nutmeg tree was 300: 300: 960g NPK $plant^{-1}$ $year^{-1}$. Urea, ployfeed imported grade water soluble fertilizers were used. The Growth characters was recorded for individual treatments and economics viz., gross return, net return, benefit : cost ratio were worked out, considering the current market price for inputs and outputs and expressed in Rs ha^{-1}

RESULT AND DISCUSSION

Tree height

The fertigation treatments significantly influenced the tree height at all stages of growth (Table 1) Generally, there was a marked difference in tree height between trees which received fertigation and the trees which received soil applied fertilizers. A remarkable increase in tree height was observed due to fertigation of water soluble fertilizers rather than straight fertilizers.Application of 100 per cent recommended dose of water soluble fertilizers along with micronutrients recorded the highest tree height of 4.75 m in 2011 and 4.88 m in 2012 during fruit maturity stages respectively. The treatment 75 per cent recommended dose of water soluble fertilizers along with micronutrients was found on par with T_8 in both the years. The lowest tree height 3.45 m in 2011 and 3.67 m in 2012 was recorded due to soil application of recommended dose of fertilizers without micronutrient during both the years. Pooled mean values during 2011 and 2012 showed that application of 100 per cent RDF as WSF along with micronutrients through fertigation recorded the tree height of 4.82 m. Growth and development of tree is a consequence of excellent coordination of several processes during the growing stages of crop. Plant height is a phenotypic character not only decides the growth in terms of vigor but also had direct influence on yield by increasing the number of fruits. The enhanced growth under drip might be due to better turgidity of the cells leading to cell enlargement and better cell wall development (Viers,1972).Tree spread decides the fruiting area of nutmeg that directly influences the vigour of tree and resulted in higher yield.

Trunk girth

A gradual increase in trunk girth was observed (Table 1). Significant enhancement in trunk girth was shown by fertigation treatments in 2011 and 2012. The different fertigation treatment significantly influenced the trunk girth in all the stages of growth during both the years. Among the different treatments, the plants that received 100 per cent RDF through fertigation and micronutrients registered the highest trunk girth of 63.26 cm in 2011 and 69.12 cm in 2012 during fruit maturity stages respectively. The trunk girth was lesser in the absolute control 38.42 cm in 2011and 43.26 cm in 2012. Pooled mean values showed that, the application of 100% RDF through fertigation and micronutrients recorded the highest trunk girth of 66.19 cm at fruit maturity stages respectively in both the years Significant increase in trunk girth observed in the present investigation might be due to the better utilization of resources like water and nutrients through fertigation (Padmavathamma, 1993; Karuthamani, 2010). Nitrogen, being an important

constituent of chlorophyll, proteins and amino acids, promoted the photosynthetic efficiency of the plant system when applied in sufficient quantities (Pafli, 1965).

Specific leaf weight The specific leaf weight was significantly influenced by fertigation at fruit maturity stages in both the years. Among the different treatments 100 per cent RDF through fertigation along with micronutrients, registered the highest specific leaf weight of 4.12 g cm^{-2} in 2011 and 4.09 g cm^{-2} in 2012 during fruit maturity stages. Pooled mean values showed that, the application of 100% RDF through fertigation along with micronutrients recorded the highest specific leaf weight 4.10 g cm^{-2} at fruit maturity stages respectively for both the years. The specific leaf weight is considered to be good indicator of the photosynthetic capacity of leaves Wallace *et al., (1972*). The increase in specific leaf weight by fertigation could be directly related to better photosynthetic efficiency by stocking of more number of palisade cells. (Shinde and Jadhaw, 1995).

Table 1
Effect of fertigation on growth characters of nutmeg at fruit maturity stage

	Tree height (cm)			*Trunk girth (cm)*			*Specific leaf weight(g cm^{-2})*		
	2011	*2012*	*Pooled mean (2011 & 2012)*	*2011*	*2012*	*Pooled mean (2011 & 2012)*	*2011*		*Pooled mean (2011 & 2012)*
T_1	3.45	3.67	3.56	38.42	43.26	40.84	2.59	2.62	2.60
T_2	3.73	4.03	3.88	46.11	54.16	50.14	2.83	2.85	2.84
T_3	3.82	4.05	3.94	48.13	57.21	52.67	3.29	3.31	3.30
T_4	3.84	4.09	3.97	48.19	57.26	52.73	3.35	3.33	3.34
T_5	3.87	4.12	4.00	49.32	58.22	53.77	3.42	3.43	3.42
T_6	3.89	4.15	4.02	50.37	58.25	54.31	3.49	3.51	3.50
T_7	4.71	4.85	4.78	61.25	69.09	65.17	3.73	3.78	3.75
T_8	4.75	4.88	4.82	63.26	69.12	66.19	4.12	4.09	4.10
T_9	4.13	4.27	4.20	52.57	59.44	56.00	3.55	3.56	3.55
T_{10}	4.17	4.30	4.24	51.02	59.42	55.22	3.47	3.49	3.48
SEd	0.096	0.102	0.070	1.229	1.420	0.938	0.080	0.082	0.057
CD (0.05)	0.201	0.214	0.140	2.581	2.983	1.887	0.172	0.1721	0.115

Economics

The economics worked for different treatments showed that 100% water soluble fertilizers under fertigation along with micronutrients recorded highest benefit: cost ratio for both the years respectively in (Table2&3). High net return of nutmeg could be assured by increasing the productivity by adopting judicious management practices. In the present study, application of 100% water soluble fertilizers secured the highest gross return (7,29,144 ha^{-1}, 7,44,120 ha^{-1}), net return of (6.07,377 ha^{-1}, 6,22353 ha^{-1}) with highest benefit: cost ratio of (5.98, 6.11). In any investment economics, it is the B: C ratio which is more important to compare the profitability of the treatments to identify input technologies to improve the yield. From the foregoing discussion, it could be

Table 2
Benefit cost ratio (BCR) influenced by different fertilizer treatments during 2011

Treatments	*Estimated Seed yield (kg ha^{-1})*	*Estimated Mace yield (kg ha^{-1})*	*Gross returns (Rsha^{-1})*	*Total cost of cultivation (Rs ha^{-1})*	*Net returns (RS ha^{-1})*	*BCR*
T_1	546.00	188.76	2,77,056	84,983	1,92,073	3.26
T_2	577.20	273.00	3,36,960	85,872	2,51,088	3.92
T_3	733.20	468.00	5,00,760	1,03,852	3,96,908	4.82
T_4	858.00	499.20	5,56,920	1,06,218	4,50,702	5.24
T_5	780.00	510.12	5,40,072	1,08,591	4,31,480	4.97
T_6	686.40	391.56	4,40,856	1,05,329	3,35,527	4.18
T_7	1266.72	527.28	6,96,384	1,19,274	5,77,109	5.83
T_8	1326.00	552.24	7,29,144	1,21,766	6.07,377	5.98
T_9	1232.40	517.92	6,80,472	1,36,180	5,44,291	4.99
T_{10}	717.60	452.40	5,86,720	1,19.885	4,65,851	4.85

Table 3
Benefit cost ratio (BCR) influenced by different fertilizer treatments during 2012

Treatments	*Estimated Seed yield (kg ha^{-1})*	*Estimated Mace yield (kg ha^{-1})*	*Gross returns ('Rsha^{-1})*	*Total cost of cultivation ('Rsha^{-1})*	*Net returns ('Rsha^{-1})*	*BCR*
T_1	530.40	187.20	2,85,948	84,983	2,00,964	3.36
T_2	580.32	274.56	3,37,061	85,872	2,51,189	3.92
T_3	748.80	502.32	5,26,032	1,03,852	4,22,179	5.06
T_4	889.20	531.96	5,85,936	1,06,218	4,79,718	5.51
T_5	811.20	517.92	5,54,112	1,08,591	4,45,521	5.10
T_6	717.60	408.72	4,60,512	1,05,329	3,55,183	4.83
T_7	1301.04	541.32	7,15,104	1,19,274	5,95,829	5.99
T_8	1357.20	561.60	7,44,120	1,24,766	6,22,353	6.11
T_9	1248.00	535.08	6,95,448	1,36,180	5,59,268	5.51
T_{10}	733.20	468.00	5,86,572	1,19,885	4,65,703	4.85

concluded that application of 100% water soluble fertilizer along with micronutrieits showed superiority over other treatments.

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