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Effect of Integrated Nutrient Management on Flowering, Fruiting and Fruit Characters in Noni (Morinda Citrifolia L.)

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Abstract **– Noni (*Morinda citrifolia* L.) is an evergreen tree species belonging to family rubiaceae. The fruits of noni are found have vast medicinal benefits. Flowering and fruiting in noni are observed almost throughout the year and hence continuous supply of nutrients may help in realizing better yields. The present experiment was conducted to study the effect of applied nutrients on flowering and fruiting in noni with seven treatments *viz.*, T_1 - Control – no fertilizer application, T_2 - 50:100:100 kg ha^{-1} NPK, T_3 - 50:225:50 kg ha^{-1} NPK, T_4 - 50:100:100 kg ha^{-1} NPK wherein 50% of recommended P supplied through bone meal, T_5 - 50:225:50 kg ha^{-1} NPK wherein 50% of recommended P supplied through bone meal, T_6 - 50:100:100 kg ha^{-1} NPK wherein 100% of recommended P supplied through bone meal and T_7 - 50:225:50 kg ha^{-1} NPK wherein 100% of recommended P supplied through bone meal. Among theses the treatments T_5 and T_7 have proven best in terms earliness in flowering, fruit length, width, weight and volume.**

Keywords **– Noni, Morinda Citrifolia, Bonemeal, Nutrient, Flowering, Fruiting.**

I. Introduction

Noni (*Morinda citrifolia* L., Rubiaceae) is a tropical, evergreen tree species. Also known as Indian mulberry, noni is native of South East Asia. The fruits of noni are known to possess immense medicinal benefits ranging from common indigestion to anti-cancer properties. Noni juice is used to treat diverse conditions, including hypertension, diabetes mellitus, bronchial asthma, rheumatoid arthritis, some cancers, and sexual dysfunction. It has also been reported that an extract from the root of the noni plant exhibited significant analgesic activity in the CNS of mice [1]. The fruit juice is reported to possess anti-microbial and antibacterial properties [2]. Noni grows well naturally in forest lands, near the coast, in open lowlands and grasslands [3]. It is a sturdy plant and can tolerate adverse soil and climatic conditions. Flowering and fruiting in noni are observed almost throughout the year and hence continuous supply of nutrients may help in realizing better yields. No much work has been done on nutrient requirement of the crop since much of the world supply of noni comes from wild. The present experiment was conducted to study the effect of applied nutrients on flowering and fruiting in noni.

II. Material and Methods

The study was conducted at Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bengaluru, Karnataka state, during 2013 to 15. The study material comprised of noni trees which were about Eight years old with seven treatments viz., T_1- Control (no fertilizer application), T_2 - 50:100:100 kg ha^{-1} NPK, T_3 - 50: 225:50 kg ha^{-1} NPK, T_4 - 50:100:100 kg ha^{-1} NPK - 50% of recommended P through bone meal, T_5 - 50:225:50 kg ha^{-1} NPK - 50% of recommended P through bone meal, T_6- 50:100:100 kg ha^{-1} NPK - 100% of recommended P through bone meal and T_7 - 50:225:50 kg ha^{-1} NPK - 100% of recommended P through bone meal. The treatments were arranged in Randomized Complete Block Design and replicated thrice. The fertilizers were given in two equal split doses as per the treatment. The observations on flowering and fruiting parameters were recorded at regular intervals as the tree flowers and fruits throughout the year.

The observations on flowering and fruiting were recorded from the randomly tagged branches in all the four directions of the canopy. Fruit length and width were measured using a digital vernier caliper. Volume of fruits was measured by water displacement method and expressed in cm^3.

III. Results and Discussion

The duration from initiation of flower bud to an thesis was least in T_7 - 46.47 days followed by T_5 which took 49.00 days and T_3 (49.60 days). This might be due to the application of higher doses of phosphorus and bone meal - a rich source of phosphorus which is an important element essential for initiation of flowering and stimulates early maturity [4]. The results are in line with the earlier findings in coconut [5] and in mango [6] who also reported stimulation effects of phosphorus on flowering.

The data pertaining to peak flowering period of noni in a year are illustrated in Figure 1. The results revealed that the peak flowering months in the year were July and August, while the intensity of flowering was the least in February and January months. There was no definite pattern observed among the treatments for peak flowering, indicating the influence of season rather than nutrition on flowering in noni.

The variation among the treatments with respect to flower duration was significant as depicted in table 1. The treatment T_3 recorded significantly minimum flower duration of 5.47 days which was statistically *on par* with T_4 (5.90 days), T_7 (6.00 days) and T_6 (6.40 days). Maximum flower duration was recorded in (T_1) control (7.17 days).

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The data pertaining to the number of days taken from fruit set to maturity revealed the presence of significant variation among the treatments for the trait. The treatments T_3 (50:225:50 kg ha^{-1} NPK) and T_7 (50:225:50 kg ha^{-1} NPK-100% of recommended P through bone meal) took 19.00 days from fruit set to maturity which were *on par* with all other treatments except control that registered 22.37 days for fruit maturity.

The maximum fruit length was recorded in the treatment T_7 (3.97 cm) followed by T_5 (3.96 cm) and the least was in the control (3.64 cm) receiving no nutrients (table 2). Significant variations were observed for fruit width among different treatments and maximum fruit width was recorded in the trees supplied with T_5 level of treatments (50:225:50 kg ha^{-1} NPK - 50% of recommended P through bone meal) (3.79 cm). The least fruit width of 3.49 cm was recorded in control (T_1). It is clear that the supply of nutrients to plants have an added advantage over no fertilizer application. The results are in conformity with that in mango [6 & 7]. Significant positive effects of phosphorus on fruit size, weight, pulp content and pulp to seed ratio in ber with the application of different levels of phosphorus were also reported earlier [8], which the authors attributed to increased growth, root development and increased cell division resulting in more photosynthates and increased absorption of water and nutrients from the soil.

The fruit weight was maximum (29.97g) in the trees supplied with 50:225:50 kg ha^{-1} NPK - 50% of recommended P through bone meal (T_5) followed by T3 (50:225:50 kg ha^{-1} NPK) which recorded an average fruit weight of 28.37g. Similarly the fruit volume was also maximum (26.23 cm^3) in T_5. The least fruit weight (21.99g) and least volume (19.19 cm^3) among the treatments were recorded in T_1 (Control). The increase in fruit weight and volume in T_5 and T_3 could be attributed to ready availability of higher levels of phosphorus along with nitrogen and potassium. Nitrogen is an essential element in proteins and chlorophyll and promotes better growth. N also governs the utilization of P, K and other elements. Potassium also helps in formation of proteins, chlorophyll, starch and sugars. Phosphorus promotes better root development thereby making the plants absorb more nutrients leading to better growth and in turn increased photosynthetic efficiency and accumulation of more carbohydrates [9], thereby enhancing fruit weight and yield. The results are in conformity with the results obtained in sweet orange [10]; in guava [11 & 12] and in ber [13] (table 3).

IV. Conclusion

In noni though the flowering is throughout the year, July and August months were found to be the peak flowering period. The treatment T_5 comprising of application of 50:225:50 kg ha^{-1} NPK wherein 50% of recommended P was supplied through bone meal has resulted in early flowering and better fruit parameters in terms of fruit weight and volume. Though noni is known to be a sturdy plant that grows naturally with no external supplement of nutrients, this preliminary study has proven that it responds well to added nutrients. Since the literature on this aspect in noni is limited there is a need to take up further nutrient trials with different combinations of major and minor nutrients on the performance of the crop for growth, yield and fruit quality.

Table 1. Effects of integrated nutrient management practices on flower duration and fruit maturity in noni (Morinda citrifolia L.)

Treatments		Days from bud initiation to anthasis	Flower duration (Days)	Days taken from fruit set to maturity
T_1	Control – no fertilizer application	65.93	7.17	22.37
T_2	50:100:100 kg ha^{-1} NPK	63.47	7.10	20.33
T_3	50:225:50 kg ha^{-1} NPK	49.60	5.47	19.00
T_4	50:100:100 kg ha^{-1} NPK-50% of recommended P through bone meal.	61.40	5.90	20.83
T_5	50:225:50 kg ha^{-1} NPK-50% of recommended P through bone meal.	49.00	6.50	19.30
T_6	50:100:100 kg ha^{-1} NPK-100% of recommended P through bone meal.	61.33	6.40	21.67
T_7	50:225:50 kg ha^{-1} NPK-100% of recommended P through bone meal.	46.47	6.00	19.00
	F-test	*	*	*
	SEm±	0.96	0.31	0.67
	CD at 5% level	2.95	0.96	2.06

* Significant at 5% level

Table 2. Effect of integrated nutrient management practices on fruit length and width in noni (Morinda citrifolia L.)

Treatments		Fruit length (cm)	Fruit width (cm)
T_1	Control – no fertilizer application	3.64	3.49
T_2	50:100:100 kg ha^{-1} NPK	3.75	3.63
T_3	50:225:50 kg ha^{-1} NPK	3.88	3.61
T_4	50:100:100 kg ha^{-1} NPK-50% of recommended P through bone meal.	3.70	3.73
T_5	50:225:50 kg ha^{-1} NPK-50% of recommended P through bone meal.	3.96	3.79
T_6	50:100:100 kg ha^{-1} NPK-100% of recommended P through bone meal.	3.82	3.71
T_7	50:225:50 kg ha^{-1} NPK-100% of recommended P through bone meal.	3.97	3.50
	F-test	NS	*
	SEm±	0.08	0.06
	CD at 5% level	-	0.20

* Significant at 5% level, NS – Non Significant

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Table 3. Effect of integrated nutrient management practices on weight and volume of noni (Morinda citrifolia L.) fruit

Treatments		Fruit weight (g)	Fruit volume (cm^3)
T_1	Control – no fertilizer application	21.99	19.19
T_2	50:100:100 kg ha^{-1} NPK	25.52	20.40
T_3	50:225:50 kg ha^{-1} NPK	28.27	23.78
T_4	50:100:100 kg ha^{-1} NPK-50% of recommended P through bone meal	25.74	25.47
T_5	50:225:50 kg ha^{-1} NPK-50% of recommended P through bone meal	29.97	26.23
T_6	50:100:100 kg ha^{-1} NPK-100% of recommended P through bone meal	25.30	22.31
T_7	s50:225:50 kg ha^{-1} NPK-100% of recommended P through bone meal	24.00	25.00
	F-test	*	*
	SEm±	0.56	0.79
	CD at 5% level	1.73	2.45

* Significant at 5% level

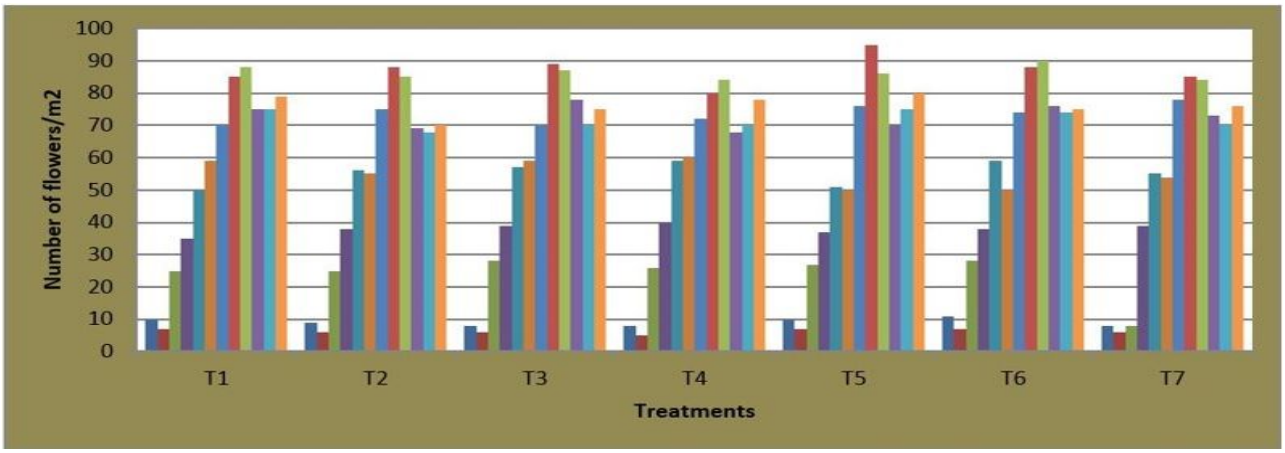

Fig. 1. Effect of season and treatments on flowering in noni (Morinda citrifolia L.)

T_1- Control
T_2- 50:100:100 kg ha^{-1} NPK
T_3- 50:225:50 kg ha^{-1} NPK
T_4- 50:100:100 kg ha^{-1} NPK-50% of recommended P through bone meal
T_5- 50:225:50 kg ha^{-1} NPK-50% of recommended P through bone meal
T_6- 50:100:100 kg ha^{-1} NPK-100% of recommended P through bone meal
T_7- 50:225:50 kg ha^{-1} NPK-100% of recommended P through bone meal

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