

Original Research Article

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Nutrient Scheduling for Baby Corn (*Zea mays* L.) Intercropped in Coconut Garden

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ABSTRACT

A field experiment was conducted at the Coconut Research Station, Balaramapuram, Thiruvananthapuram, during the summer season to work out an economic nutrient management schedule for baby corn intercropped in coconut garden. The experiment was laid out in randomized block design with 10 treatments replicated thrice, using the baby corn hybrid, G 5414 as a test variety. Plant height (125.16 cm) at 30 days after emergence (DAE), number of leaves per plant at 45 DAE (11.87), leaf area index at 15 DAE (0.365), 30 DAE (2.25) and 45 DAE (4.28) and dry matter production (24203.70 kg ha⁻¹) were significantly superior at T₇. The yield attributes viz., cob length (11.60 cm), cob girth (5.30 cm) and cob weight with husk (84.22 g plant⁻¹) recorded significantly higher values at T₇. Similar results were also recorded with respect to cob yield with husk (17162.66 kg ha⁻¹), marketable cob yield (6720.67 kg ha⁻¹) and green stover yield (26203.70 kg ha⁻¹). All the above yield attributes (except cob weight with husk) were on a par with T₄. The uptake of nitrogen (304.64 kg ha⁻¹), phosphorus (59.65 kg ha⁻¹) and potassium (277.01 kg ha⁻¹) was significantly higher with the treatment T₇. Gross income (₹ 2,68,827 ha⁻¹), net income (₹ 1,90,367 ha⁻¹) and benefit cost ratio (3.43) were significantly higher in T₇. Baby corn intercropped in coconut garden was observed to be superior with the application of FYM @ 12.5 t ha⁻¹ + 135: 65: 45 kg NPK ha⁻¹ (½ N + full P + K as basal; ½ N + ½ K @ 25 DAS).

Keywords

Baby corn,
Economic, Growth,
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Introduction

Maize, referred to as the 'king of cereals' is a good grain crop with high yield potential, superior fodder quality and dual purpose value as comparable to other food crops. Baby corn is one such dual purpose maize, whose global

spread, increasing demand and premium price has made it an attractive option for the farmers in many countries including India. It has the potential of producing high biomass within a short period of time and can also serve as a source of fresh fodder, especially during the summer months. Baby corn because of its

fodder value and more profitability than grain maize is helpful in raising the income of the farmers near metros and big cities (Pandey *et al.*, 2000). It is so called because young, fresh and finger like green ears are harvested before or just at the time of silk emergence and before fertilization, which upon dehusking and desilking is used as vegetable. Baby corn ears are light yellow colour with regular row arrangement, 10 to 12 cm long and a diameter of 1.0 to 1.5 cm sizes are preferred in the market (Muthukumar *et al.*, 2005). Further, it is a low calorie, zero cholesterol food with high fibre content (Nagdeve *et al.*, 2014). The land and climate of Kerala is suitable for a number of crops. About 45 per cent of the net area sown is under perennial crops like coconut. Studies conducted in Tamil Nadu and isolated pockets in Kerala, have shown that baby corn production could be an important on-farm income generation activity when intercropped with annual crops (Thavaprakash and Velayudham, 2008) and perennial crops like coconut (CPCRI, 2012). Baby corn is comparatively a new crop for Kerala and small farmers are often hesitant in trying new crops under sole cropping situations, since it involves certain degree of risk. Coconut gardens provide ample scope for intercropping. Baby corn production being a very recent development, cultivation practices, especially nutrient management needs to be standardized before it finds a prominent place in the existing cropping systems with the following objectives to standardize the nutrient schedule for baby corn intercropped in coconut garden and to work out the economics.

Materials and Methods

A field experiment was conducted at the Coconut Research Station, Balaramapuram, Thiruvananthapuram, during the summer season (March to May), 2017. The soil of experimental field was sandy loam in texture,

acidic in reaction (pH 4.60), low in available nitrogen (200.70 kg N/ha), medium in available phosphorus (18.56 kg P/ha) and available potassium (108.70 kg K/ha). The experiment was laid out in randomised block design with 10 treatments replicated thrice, using the baby corn hybrid, G 5414 as the test variety. The treatments comprised combinations of 3 nutrient doses, 3 split application schedules and a control. The treatments were T₁ : 100:40:60 kg NPK ha⁻¹ (½ N + ½ K basal; ½ N + ½ K at 25 DAS); T₂ : 100:40:60 kg NPK ha⁻¹ (½ N + ½ K basal; ½ N + ½ K at 45 DAS); T₃ : 100:40:60 kg NPK ha⁻¹ (½ N + ½ K basal; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS); T₄ : 150:60:40 kg NPK ha⁻¹ (½ N + ½ K basal; ½ N + ½ K at 25 DAS); T₅ : 150:60:40 kg NPK ha⁻¹ (½ N + ½ K basal; ½ N + ½ K at 45 DAS); T₆ : 150:60:40 kg NPK ha⁻¹ (½ N + ½ K basal; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS); T₇ : 135:65:45 kg NPK ha⁻¹ (½ N + ½ K basal; ½ N + ½ K at 25 DAS); T₈ : 135:65:45 kg NPK ha⁻¹ (½ N + ½ K basal; ½ N + ½ K at 45 DAS); T₉ : 135:65:45 kg NPK ha⁻¹ (½ N + ½ K basal; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS) and T₁₀ : control. Farm yard manure @ 12.5 t ha⁻¹ was applied uniformly to all the treatments, including control. The entire dose of phosphorus was applied basally to the treatments T₁ to T₉.

Biometric observations were recorded from six plants selected at random in the net plot. Plant height was measured from base to tip of the terminal leaf on the main stem and expressed in cm. The number of functional leaves per plant was recorded by counting the fully opened green leaves. Leaf area index was measured by using the formula given by (Balakrishnan *et al.*, 1987). The uprooted plants were dried under shade and then oven dried at 60 + 5 °C till a constant weight was obtained and expressed in kg ha⁻¹. Weight of cobs with husk from the tagged plants was measured. Sheath of cobs was peeled-off and

the length and diameter of corn were measured. The weight of the unhusked cobs was recorded and expressed in kg ha⁻¹. The cobs from the sample plants were dehusked and weight of the corn was recorded and the total marketable cob yield was expressed in kg ha⁻¹. After the final harvest of the cobs, the plants of each net plot was cut close to the ground, weighed and weight was expressed in kg ha⁻¹. Nitrogen, phosphorus and potassium in plants were estimated by the standard methods advocated by Jackson (1973).

Gross income was calculated by multiplying the marketable cob yield with the market price of the produce and expressed as gross income in ₹ ha⁻¹. The net returns was calculated by deducting the cost of cultivation from the gross returns and expressed in ₹ ha⁻¹. Ratio of net return to cultivation cost was the benefit cost ratio. The data generated from the experiment were statistically analyzed using Analysis of Variance technique (ANOVA) as applied to Randomised Block Design (Panse and Sukhatme, 1985).

Results and Discussion

Growth and growth attributes

Plant height of baby corn was observed to vary significantly among the different nutrient schedules, at 30 days after emergence (DAE). The plants were significantly taller in T₇ (135: 65: 45 kg NPK ha⁻¹; ½ N + ½ k as basal; ½ N + ½ K at 25 DAS), which was on par with T₄ (150: 60: 40 kg NPK ha⁻¹; ½ N + ½ k as basal; ½ N + ½ K at 25 DAS).

The effect of nutrient schedules was significant with respect to the number of leaves per plant at 45 DAE. Leaf number was significantly higher (11.89) in T₇. It remained at par with all the other treatments, except T₈ and T₁₀ (control). Significantly higher leaf area index was recorded with the treatment T₇ at 15 DAE (0.365), 30 DAE (2.254) and 45

DAE (4.286). Balanced nutrition might have supported rapid cell division and elongation of cells, there by contributing to improved growth attributes of baby corn. Similar results have been observed by Sobhana *et al.* (2012) and Kumar and Bohra (2014).

The treatment T₇ (24203.70 kg ha⁻¹) proved significantly superior in terms of the total dry matter produced by baby corn. Dry matter production is a function of plant height, number of leaves, leaf area index and yield. Among the three major nutrients, nitrogen plays an important role in plant growth, since it is an integral constituent of cell component (Mohan *et al.*, 2015).

Further Muchow and Davis (1988) have reported that nitrogen fertilization of maize influenced the dry matter yield by influencing the leaf area index and photosynthetic efficiency. Potassium application improves leaf area, dry matter accumulation and other allometric parameters. K in combination with N has synergistic influence in uptake, translocation and utilization of nutrients for assimilation in growth and development and yield and its contributing attributes (Ahmad *et al.*, 2012) (Table 1).

Yield attributes and yield

The yield attributes *viz.*, cob length (11.60 cm), cob girth (5.30 cm) were significantly higher with treatment T₇ (135:65:45 kg NPK ha⁻¹ ½ N + ½ K basal; ½ N + ½ K at 25 DAS) which was on par (11.33 cm and 5.13 cm cob length and cob girth respectively) with T₄ (150: 60: 40 kg NPK ha⁻¹; ½ N + ½ K basal; ½ N + ½ K at 25 DAS). Significantly higher cob weight with husk (84.22 g plant⁻¹) was recorded by the treatment T₇ and it was followed by T₄ with a cob weight of 79.58 g plant⁻¹ (Table 2).

Table.1 Effect of nutrient schedules on growth attributes of baby corn

Treatments	Plant height (cm)			Number of leaves (no. plant ⁻¹)			Leaf area index			Total dry matter (kg ha ⁻¹)
	15 DAE	30 DAE	45 DAE	15 DAE	30 DAE	45 DAE	15 DAE	30 DAE	45 DAE	
T₁ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	49.20	108.85	159.06	5.05	7.99	11.55	0.25	1.95	3.72	18757.40
T₂ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	50.87	108.55	170.38	4.99	7.78	11.55	0.21	1.68	3.38	17631.48
T₃ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	43.96	107.83	165.80	4.61	7.67	11.72	0.24	1.87	3.52	17192.59
T₄ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	45.68	122.74	165.23	4.94	7.61	11.66	0.30	2.02	4.06	19913.06
T₅ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	51.47	114.14	170.40	5.27	8.33	11.50	0.26	1.97	3.52	18940.747
T₆ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	47.88	108.31	166.91	4.94	7.66	11.77	0.28	1.99	3.67	19215.74
T₇ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	50.30	125.16	172.30	5.11	7.83	11.89	0.36	2.25	4.29	24203.70
T₈ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	45.54	112.56	166.73	5.17	8.28	11.28	0.34	1.98	3.91	9858.33
T₉ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	50.78	115.91	171.26	5.05	8.33	11.55	0.31	2.03	4.02	17459.25
T₁₀ : Control	43.68	96.52	146.68	4.99	7.33	10.72	0.14	1.42	2.29	13191.66
SE m (±)	2.83	3.54	3.74	0.11	0.28	0.18	00	0.03	0.05	436.23
CD (0.05)	NS	10.519	NS	NS	NS	0.555	0.029	0.100	0.168	1296.186

DAE: Days after emergence DAS: Days after sowing

Note: Farm yard manure @ 12.5 t ha⁻¹ was applied uniformly to all the treatments, including control. The entire dose of phosphorus was applied as basal in treatments T₁ to T₉.

Table.2 Effect of nutrient schedules on yield attributes and yields of baby corn

Treatments	Length of cob (cm)	Girth of cob (cm)	Cob weight with husk (g plant ⁻¹)	Cob yield with husk (kg ha ⁻¹)	Marketable cob yield (kg ha ⁻¹)	Green stover yield (kg ha ⁻¹)
T₁ : 100 : 40 : 60 kg NPK ha ⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	9.63	4.33	75.68	12768.52	4589.50	22083.30
T₂ : 100 : 40 : 60 kg NPK ha ⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	8.86	3.70	74.14	10648.14	3882.71	21620.33
T₃ : 100 : 40 : 60 kg NPK ha ⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	9.10	4.20	75.68	11495.37	4165.12	20324.10
T₄ : 150 : 60 : 40 kg NPK ha ⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	11.33	5.13	79.58	15532.66	6177.55	23013.90
T₅ : 150 : 60 : 40 kg NPK ha ⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	9.73	3.93	74.77	14129.62	5043.20	22495.37
T₆ : 150 : 60 : 40 kg NPK ha ⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	10.50	4.60	75.58	14574.07	5191.35	21643.50
T₇ : 135 : 65 : 45 kg NPK ha ⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	11.60	5.30	84.22	17162.03	6720.67	26203.70
T₈ : 135 : 65 : 45 kg NPK ha ⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	10.06	4.66	79.04	13611.11	4870.37	23194.48
T₉ : 135 : 65 : 45 kg NPK ha ⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	10.35	4.13	78.32	11884.25	4294.75	20925.93
T₁₀ : Control	8.50	3.43	62.70	8715.27	1496.96	15138.87
SE m (±)	0.15	0.07	1.44	600.62	189.59	607.21
CD (0.05)	0.448	0.283	5.897	1784.584	563.328	1804.166

DAE: Days after emergence DAS: Days after sowing

Note: Farm yard manure @ 12.5 t ha⁻¹ was applied uniformly to all the treatments, including control. The entire dose of phosphorus was applied as basal in treatments T₁ to T₉.

Table.3 Effect of nutrient schedules on uptake of nitrogen, phosphorus and potassium, kg ha⁻¹

Treatments	Nutrient uptake		
	Nitrogen	Phosphorus	Potassium
T₁ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	249.43	38.41	244.99
T₂ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	195.87	35.92	173.07
T₃ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	200.10	33.42	212.22
T₄ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	298.23	43.55	183.67
T₅ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	230.54	43.43	175.50
T₆ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	254.19	42.11	195.66
T₇ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	304.63	59.65	277.01
T₈ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	221.64	45.98	177.00
T₉ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	223.05	40.43	192.96
T₁₀ : Control	122.28	21.30	58.03
SE m (±)	10.47	1.11	13.37
CD (0.05)	31.136	5.730	39.740

DAS: Days after sowing

Note: Farm yard manure @ 12.5 t ha⁻¹ was applied uniformly to all the treatments, including control. The entire dose of phosphorus was applied as basal in treatments T₁ to T₉.

Table.4 Effect of nutrient schedules on gross income, net income and B: C ratio

Treatments	Gross income	Net income	B:C ratio
T₁ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	183580	106606	2.39
T₂ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	155308	78334	2.02
T₃ : 100 : 40 : 60 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	166604	88366	2.13
T₄ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	247102	168617	3.15
T₅ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	201728	123243	2.57
T₆ : 150 : 60 : 40 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	207654	126642	2.57
T₇ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 25 DAS	268827	190367	3.43
T₈ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ½ N + ½ K at 45 DAS	194814	116354	2.48
T₉ : 135 : 65 : 45 kg NPK ha⁻¹ ½ N + ½ K basal ; ¼ N + ¼ K at 25 DAS; ¼ N + ¼ K at 45 DAS	171790	91435	2.13
T₁₀ : Control	59878	-850	0.98
SE m (±)	7583.67	7583.67	0.09
CD (0.05)	22533.073	22533.073	0.285

DAS: Days after sowing

Note: Farm yard manure @ 12.5 t ha⁻¹ was applied uniformly to all the treatments, including control. The entire dose of phosphorus was applied as basal in treatments T₁ to T₉.

The treatment T₇ (135: 65: 45 kg NPK ha⁻¹; ½ N + ½ K as basal; ½ N + ½ K at 25 DAS) produced significantly larger cobs (in terms of both length and girth), higher cob yield with husk (17162.03 kg ha⁻¹) and marketable cob yield (6720.67 kg ha⁻¹) and remained at par (15532.66 kg ha⁻¹ and 6177.55 kg ha⁻¹ cob yield with husk marketable cob yield respectively) with T₄ (150: 60: 40 kg NPK ha⁻¹; ½ N + ½ K as basal; ½ N + ½ K at 25 DAS). Significantly higher green stover yield (26203.70 kg ha⁻¹) was obtained in T₇.

The results suggested the positive influence of nutrients in increasing the marketable cob yield. Increased level of NPK might have provided the crop with a balanced nutrient supply resulting in improved growth attributes such as plant height, leaf area index and dry matter production and consequently increased the yield attributes and yield of baby corn. Similar results have been reported by (Sobhana *et al.*, (2012) and Kumar and Bohra (2014). Improvement in marketable cob yield could be attributed to the higher photosynthetic rates at T₇ and T₄ resulting from better light interception, light absorption and radiation use efficiency. This is in consonance with the findings of Madhavi *et al.* (1995) and Thavaprakash *et al.* (2005).

Nutrient uptake

Nutrient schedules had significant effect on nutrient uptake. Uptake of nitrogen, phosphorus and potassium was significantly higher in T₇ (135: 65: 45 kg NPK ha⁻¹; ½ N + ½ k as basal; ½ N + ½ K at 25 DAS). The treatment T₇ was observed to record significantly higher plant height, leaf area index, marketable cob yield, green stover yield and consequently higher dry matter production. Nutrient uptake is the function of dry matter production and nutrient content. This is also in accordance with the findings of Fageria and Baligar (2005) who have stated

that nutrient accumulation pattern in plant followed dry matter accumulation (Table 3).

Economics

The cost of inputs and produce vary widely, both temporally and spatially. Cost of cultivation was highest at T₆ (150: 60: 40 kg NPK ha⁻¹; ½ N + ½ k as basal; ¼ N + ¼ K at 25 DAS and ¼ N + ¼ K at 45 DAS). This might be due to the higher nutrient dose clubbed together with two top dressings. Cost of cultivation was least for control. However, the higher cost of cultivation in T₆ was not compensated with an equally high gross income, net income and BCR.

Gross income (₹ 268827 ha⁻¹), net income (₹ 190367 ha⁻¹) and BCR (3.43) were significantly high for the treatment T₇. It was on par with T₄ which recorded a gross income of ₹ 247102 ha⁻¹, net income of ₹ 168617 ha⁻¹ and BCR of 3.15. The effect of the treatments T₇ and T₄ could be attributed to the significantly high marketable cob yield (Table 4).

In conclusion, growth attributes, yield attributes, yield, nutrient use efficiency and profitability of baby corn intercropped in coconut garden was observed to be superior with the application of FYM @ 12.5 t ha⁻¹ + 135: 65: 45 kg NPK ha⁻¹ (½ N + full P + K as basal; ½ N + ½ K @ 25 DAS).

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