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Diagnosis of nutrient content and standardization of leaf sampling technique in jackfruit

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Abstract
In Karnataka, jackfruit, which was mostly regarded wild and not grown as a crop, has found some takers. Less information was known about the nutrient requirements of jackfruits, and conventional nutrient management is usually based on experience. As a result, an attempt was conducted in this study to standardize the leaf collection procedure and the appropriate range of leaf nutrient contents for determining jackfruit nutrient status. Factors such as canopy height, leaf age and time of sampling were considered while sampling. These factors will have an impact on the results. The results showed that the level of nutrient concentrations was stable from 3-6 months old leaves from central canopy. During April to June, the months was most consistent. It was advised that the stable intra-canopy and stable period of nutrient concentrations could be used as the standards for leaf sampling technique. Based on the leaf sampling technique, the standard of leaf nutrient concentrations was summarized and could be used as the standard for nutrient suitability evaluation.

Keywords: Jackfruit, nutrient status diagnosis, leaf sampling technique and standardization

Introduction
The commonly farmed and popular fruit of tropical areas is jackfruit. The crop was cultivated on over 5,000 hectares of land in Karnataka, with a production of 2,459 tonnes every year. Fruit is the largest tree-bore fruit, and its rapid growth depletes the soil's nutrients. For years, however, little information has been understood about the nutrient requirements of jackfruit and the leaf nutrient analysis has been frequently employed to diagnose plant nutrient status (Baldock and Schulte, 1996, Bell, 2000, Cline, 1990., Lamb, 1976, Tagliavini *et al*., 1993 and Zatylny *et al*., 2006) [3, 4, 6, 13, 17, 19]. The level of deficiency or sufficiency of the plant nutrient status can be determined by using the results of leaf analysis and the standards of leaf nutrient concentrations, and the optimum fertilization rate can be recommended (Jones 1985 and Jones *et al*., 1991) [11, 10]. However, values of leaf analysis were determined by sample techniques such as the canopy height, leaf age, and sampling time (Awasthi *et al*., 1993, Escudero *et al*., 1992, Guha *et al*., 1965 and Perica 2001) [2, 8, 9, 15] Many fruiting plants, including apple, pear, bael and lime, have been used to test the sample technique (Singh *et al*., 1990 and Kamboj *et al*., 1995) [16, 12]. However, there is still a scarcity of leaf sampling techniques in jackfruit, necessitating the collection of further data. The leaf canopy height, leaf age, and sampling time for jackfruit were determined in this paper using field sampling and leaf canopy height. Aim of this paper is to standardize jackfruit sampling and fertilizer recommendations.

Material and methods
A field experiment was conducted at the jack farm in the College of Horticulture Kolar in 2020-21. Kolar district, with an average elevation of 822 metres, is located between North latitude 12° 46' and 13° 58' and East longitude 77 to 78° 35'. (2,697 ft). The climate can be described by an average annual temperature range of 17 °C to 34 °C. Kolar is located in the agroclimatic zone of Eastern Dry. It has a semi-arid climate with hot summers and moderate winters, which is characterized by typical monsoon, tropical weather. In most cases, the year is divided into four seasons. With an average annual rainfall of 650-800 mm, they are: a) Dry season from January to March, b) Premonsoon season from April to June, c) Southwest Monsoon season from July to September and d) Post or Northeast monsoon season from October to December. Alfesols cover the earth in the experimental orchards (Red sandy loam). The leaves were collected from a population of ten trees in the orchard.

The samples were taken in the early morning (8 to 10 a.m.) from all the four directions to avoid variation at the end of each month for one year, from 2021 to 2022. The samples were brought to lab on the same day and rinsed in the tap water and distilled water, respectively.

After grinding the dried leaf samples, the analysis was performed. Total nitrogen (N), total phosphorus (P), total potassium (K), total calcium (Ca), total magnesium (Mg), total zinc (Zn), total copper (Cu), total manganese (Mn), and total iron (I) were determined using di-acid (HSO. H_2O_2) digests (Fe). The Kjeldahl digestion method was used to determine total nitrogen. A UV visible spectrophotometric technique was used to determine total P. A flame photometer was used to determine total K. Total Ca and Mg were determined using the complexometric titration method, and total Zn, Cu, Fe, and Mn were determined using the atomic absorption spectrophotometry method. After acid (HNO-HCIO-HCI) digestion, total Sulfur (S) was measured using BaCl turbidimetry. The azomethine-H spectrophotometric technique was used to determine the total Boron (B).

Mean and standard deviation of leaf nutrient concentrations were used to create a standard for deficient, low, optimum, high, and excess ranges for each nutrient. The values were derived from the "mean " 4/3 SD (standard deviation) to mean + 4/3 SD" were considered as the optimum nutrient range; the low range was obtained by calculating "mean " 4/3 SD to mean " 8/3 SD," and the values below "mean " 8/3 SD" were considered as deficient range; the values from "mean + 4/3 SD to mean +8/3 SD" were considered as high range, and the values above "mean +8/3 SD" were considered as (Anjaneyulu, 2007) [1]. Statistical Package for the Social Sciences (SPSS) statistical software was used to calculate all of the data.

Results and Discussion

The findings in this study revealed that, except from Ca, Mn, and B, the lower canopy has the highest leaf nutrient contents. The lower canopy has higher concentrations of N, P, K, Cu, and Zn in the 3-6-month-old leaves, and the lower canopy has higher concentrations of Fe in the over 6-month-old leaves. The 3-6-month-old leaves have higher N, P, K, Cu, and Zn concentrations than the over 6-month-old leaves, but lower Ca, Mn, and B concentrations. Mg and S levels in plants are relatively consistent. The stability of leaf nutrient concentrations in the jackfruit was observed in 3–6-month-old leaves from the central canopy, according to the results (Table 1).

Time of sampling

The seasonal changes in the populations of leaves on the most suitable sampling parts of jackfruit are showed in Figure 1, 2 & 3. We can see from the graph that leaf nutrient concentrations of K and Cu increase during the spring and summer, then show a considerable variation but no apparent trends. Ca, Zn, and B concentrations rise in the spring, then fall. Throughout the year, P, Mg, and S concentrations remain rather consistent. In December, the concentration of nitrogen reaches its peak (2.99%), after which it gradually declines. Fe level peaks in December (144.67 ppm), then gradually decreases until October. Mn levels at their highest in February, then begin to decline until May, then gradually increasing until September. The findings showed that the jackfruit's leaf nutrient contents remained stable throughout the growing season.

Optimum Leaf Nutrient Concentrations

The leaves were sampled in the 3-6 months old leaves from the central canopy between April and May of 2020-2021. In Table 2, the mean and range of nutrient concentrations in jackfruit leaves are shown. The leaf nutrient status of different jackfruit trees varied depending on the range of leaf nutrient concentrations. The leaf micronutrient (Zn, Cu, Mn Fe, B) concentrations are more varied than those of the leaf macronutrients (N, P, K, Ca, Mg, S). Table 3 represents the standard for leaf nutrient concentrations. N, P, K, Ca, Mg, S, Fe, Mn, Cu, Zn, and B are in the optimum range. Hidden hunger or severe deficiency is considered below the ideal range, while luxurious absorption or extreme toxicity is considered above the optimum range.

The stability of leaf nutrient concentrations in the jackfruit between April and June was observed in 3-6 months old leaves from the central canopy in this study. The most appropriate sampling parts would be those with nutrient contents that were close to the average of the entire plant (Awasthi *et al*., 1993, Bell *et al*., 1984, Dhandhar *et al*., 1993 and Mahesh *et al*., 2005) [2, 4, 7, 14]. As a result, while 6 and 7 months old leaves from the central canopy were stable for the evaluation of N, P, and K in the study of bael leaf sampling technique, the 3 and 6 months old leaves from the central canopy may be the best choice for developing foliar nutrient standards for jackfruit in this study. Furthermore, because young leaf nutrient concentrations are unstable due to their stage of continuous growth, the leaves were not collected, and because nutrients transferred or accumulated over 6-month-old leaves, the leaves were also not suitable for sampling. Other studies have found considerable changes in leaf nutrient concentrations in four directions of the same canopy (Perica, S., 2001) [15]. As a result, sampling from different directions may result in inaccurate results. As a result, more work is required to resolve this unsolved issue. The sample time when the nutrient concentrations were closest to the yearly average might be chosen as the most appropriate sampling time (Zatyiny *et al*., 2006, Bell *et al*., 1984, Perica, S. 2001, Dhandhar *et al*., 1993 and Mahesh *et al*., 2005) [19, 4, 7, 15, 14]. As a result, the wintertime was stable for the evaluation of N in the study of olive leaf sampling technique, whereas the period from April to June may be best for developing foliar nutritional standards for jackfruit in this study. Furthermore, the ripening season for Jackfruit is from June to July, and the ideal time to fertilize is after harvest. Between April and June, the nutritional condition of jackfruit was assessed in order to improve growth the next year. Following that, the most effective fertilizer plans can be developed. The inadequate range, low range, optimum range, and excess range for each nutrient make up the leaf nutrient concentration standard, which can be used to evaluate nutritional adequacy (Yan sun *et al*., 2015) [18]. However, the availability of fertilizers is closely related to soil nutrient supplying power and plant nutrient absorption capacity, therefore, how to fertilize the jackfruit in the condition of below or above the optimum range is needed further research.

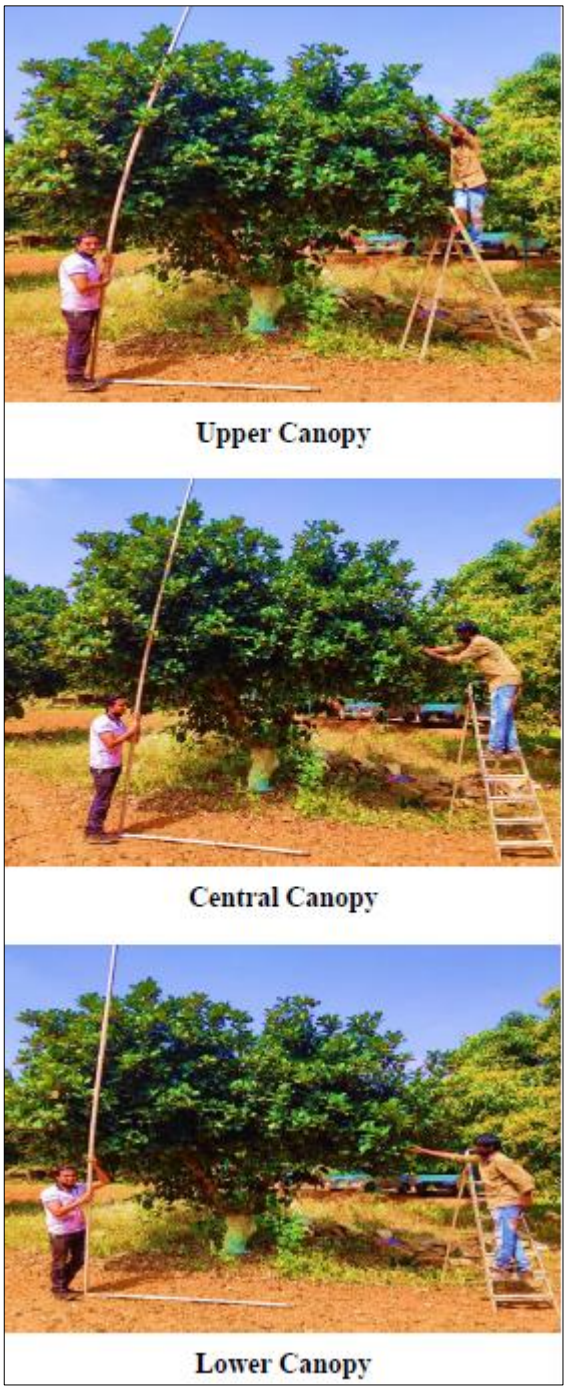

Plate 1: Collection of leaf sample from different canopy height of jackfruit tree during July-September 2020

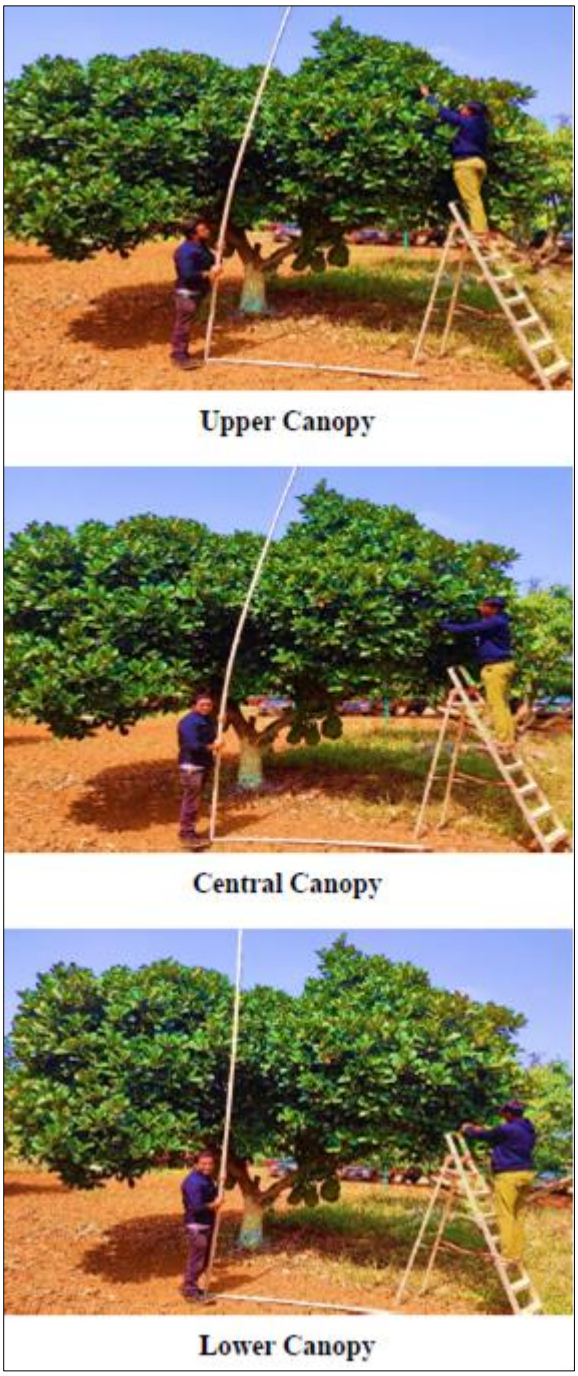

Plate 2: Collection of leaf sample from different canopy height of jackfruit tree during October-December 2020

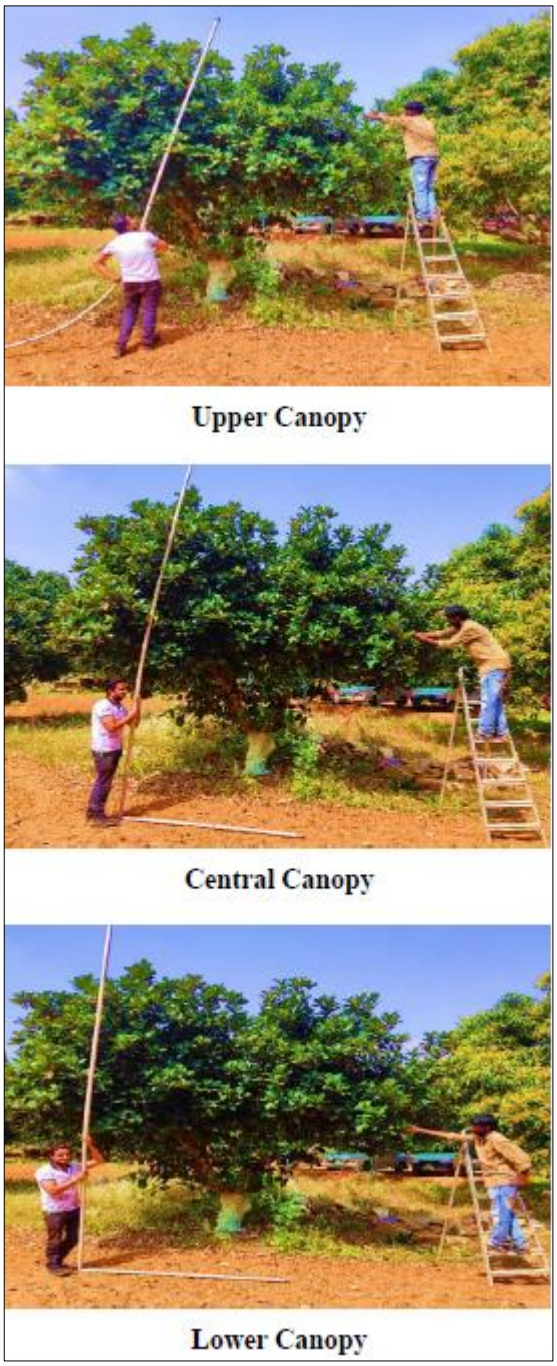

Plate 3: Collection of leaf sample from different canopy height of jackfruit tree during January-March 2021

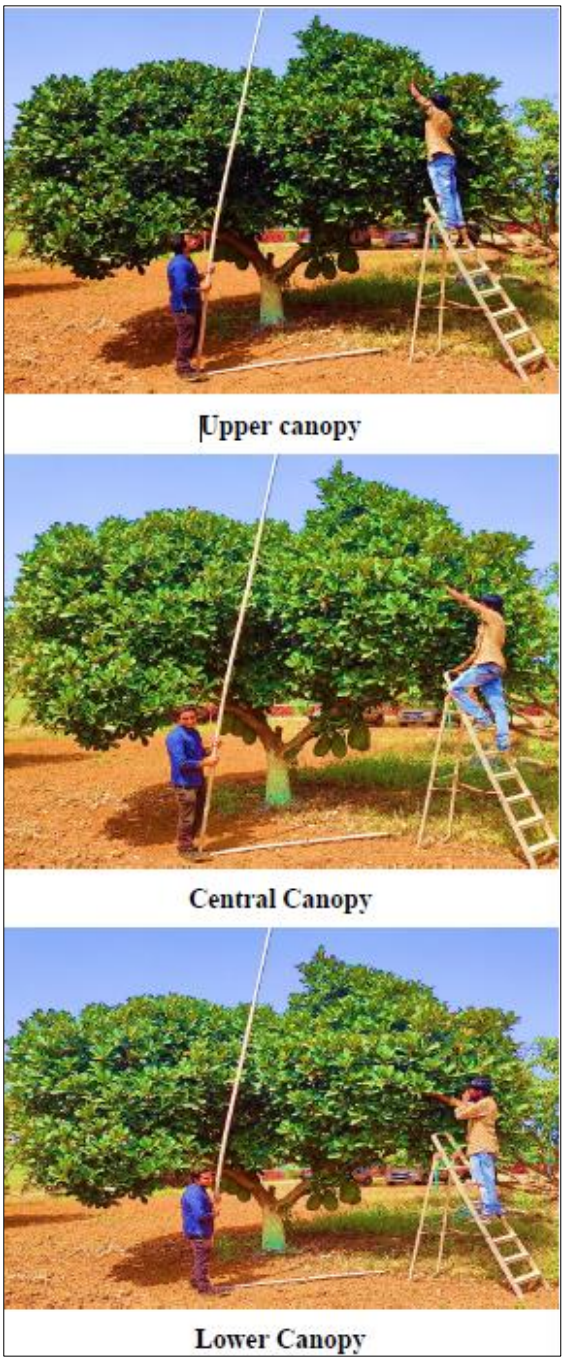

Plate 4: Collection of leaf sample from different canopy height of jackfruit tree during April-June 2021

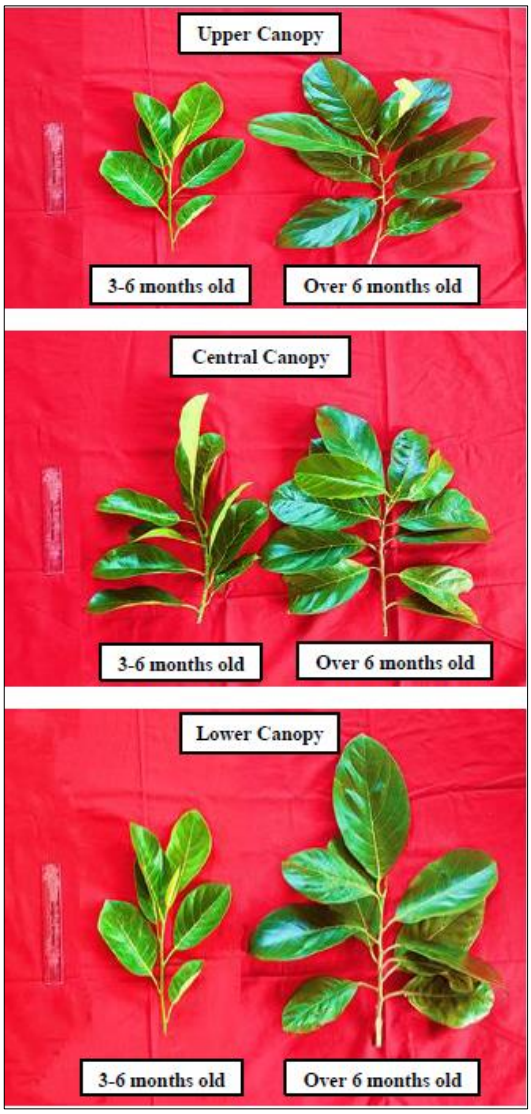

Plate 5: Branches of jackfruit tree of different leaf age and canopy height

Plate 6: Leaves of jackfruit tree of different leaf age and canopy height

Table 1: Effect of canopy height and age on jack fruit leaf total nitrogen, phosphorus and potassium content (%) during Pre-monsoon (April-June 2021)

S. No	Trees	Upper canopy						Central canopy						Lower canopy						Mean		
		Over 6-month-old leaves			3–6-month-old leaves			Over 6-month-old leaves			3–6-month-old leaves			Over 6-month-old leaves			3–6-month-old leaves					
		N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
1	A-46	2.42	0.16	1.31	2.49	0.19	1.96	2.31	0.16	1.29	1.39	0.23	1.98	2.34	0.17	1.30	2.78	0.24	2.69	2.50	0.19	1.54
2	A-128	2.34	0.13	1.34	2.33	0.17	1.89	2.21	0.13	1.32	1.38	0.19	1.91	2.28	0.15	1.34	2.60	0.22	2.59	2.39	0.17	1.53
3	B-46	2.52	0.14	1.43	2.53	0.20	2.26	2.29	0.14	1.39	1.53	0.18	2.27	2.27	0.14	1.42	2.59	0.21	2.53	2.45	0.17	1.72
4	C-38	2.58	0.15	1.47	2.51	0.19	2.10	2.28	0.15	1.41	1.57	0.21	2.13	2.30	0.16	1.43	2.64	0.23	2.62	2.49	0.18	1.69
5	D-2	2.64	0.16	1.93	2.67	0.21	2.40	2.32	0.12	1.79	2.10	0.22	2.43	2.31	0.17	1.81	2.69	0.23	2.67	2.55	0.19	2.08
6	D-26	2.76	0.18	1.95	2.74	0.22	2.56	2.33	0.15	1.83	2.24	0.19	2.54	2.29	0.15	1.86	2.60	0.22	2.58	2.55	0.19	2.16
7	D-33	2.45	0.12	1.39	2.54	0.18	2.24	2.26	0.13	1.35	1.41	0.21	2.26	2.32	0.16	1.39	2.63	0.23	2.61	2.47	0.17	1.67
8	D-81	2.49	0.14	1.41	2.48	0.17	1.88	2.27	0.13	1.40	1.52	0.18	1.90	2.26	0.14	1.43	2.59	0.21	2.56	2.44	0.16	1.59
9	E-43	2.69	0.17	1.99	2.70	0.22	2.54	2.34	0.16	1.89	2.21	0.17	2.58	2.25	0.13	1.91	2.51	0.19	2.49	2.50	0.17	2.19
10	F-56	2.59	0.16	1.48	2.65	0.21	2.41	2.28	0.14	1.41	1.90	0.18	2.45	2.27	0.14	1.98	2.53	0.20	2.51	2.47	0.17	1.94
Mean		2.55	0.15	1.57	2.56	0.20	2.22	2.29	0.14	1.51	0.20	1.73	2.25	2.29	0.15	1.59	2.62	0.22	2.59	2.48	0.18	1.81

Table 2: Effect of canopy height and age on jack fruit leaf total calcium, magnesium and sulphur content (%) during Pre-monsoon (April-June 2021)

S. No	Trees	Upper canopy						Central canopy						Lower canopy						Mean		
		Over 6-month-old leaves			3–6-month-old leaves			Over 6-month-old leaves			3–6-month-old leaves			Over 6-month-old leaves			3–6-month-old leaves					
		Ca	Mg	S	Ca	Mg	S	Ca	Mg	S	Ca	Mg	S	Ca	Mg	S	Ca	Mg	S	Ca	Mg	S
1	A-46	0.75	0.17	0.17	0.73	0.16	0.18	0.74	0.15	0.20	0.76	0.21	0.19	0.72	0.16	0.22	0.71	0.16	0.24	0.74	0.17	0.20
2	A-128	0.77	0.18	0.22	0.76	0.17	0.21	0.76	0.17	0.22	0.79	0.23	0.23	0.75	0.18	0.23	0.74	0.17	0.22	0.76	0.18	0.22
3	B-46	0.79	0.20	0.24	0.78	0.19	0.23	0.77	0.19	0.21	0.82	0.25	0.24	0.76	0.20	0.19	0.77	0.19	0.23	0.78	0.20	0.22
4	C-38	0.80	0.25	0.19	0.81	0.21	0.17	0.79	0.21	0.24	0.85	0.27	0.18	0.78	0.22	0.17	0.80	0.21	0.18	0.81	0.23	0.19
5	D-2	0.85	0.29	0.21	0.83	0.23	0.24	0.82	0.27	0.23	0.89	0.29	0.17	0.80	0.24	0.20	0.83	0.23	0.17	0.84	0.26	0.20
6	D-26	0.89	0.33	0.18	0.87	0.27	0.19	0.84	0.29	0.19	0.90	0.31	0.24	0.83	0.26	0.24	0.87	0.27	0.18	0.87	0.29	0.20
7	D-33	0.90	0.35	0.22	0.91	0.30	0.20	0.86	0.30	0.17	0.95	0.35	0.23	0.85	0.28	0.20	0.90	0.30	0.20	0.90	0.31	0.20
8	D-81	0.95	0.37	0.20	0.93	0.33	0.22	0.90	0.33	0.20	1.05	0.39	0.23	0.89	0.30	0.21	0.97	0.33	0.21	0.95	0.34	0.21
9	E-43	0.99	0.40	0.21	0.97	0.37	0.18	0.92	0.37	0.22	1.09	0.41	0.21	0.91	0.32	0.24	1.03	0.37	0.24	0.99	0.37	0.22
10	F-56	1.03	0.42	0.23	1.00	0.39	0.24	0.96	0.39	0.18	1.15	0.45	0.22	0.95	0.34	0.23	1.07	0.39	0.19	1.03	0.40	0.22
Mean		0.74	0.17	0.20	0.74	0.17	0.20	0.74	0.17	0.20	0.74	0.17	0.20	0.74	0.17	0.20	0.74	0.17	0.20	0.86	0.28	0.21

Table 3: Effect of canopy height and age on jack fruit leaf total zinc, copper and manganese content (ppm) in during Pre-monsoon (April-June 2021)

S. No	Trees	Upper canopy						Central canopy						Lower canopy						Mean		
		Over 6-month-old leaves			3–6-month-old leaves			Over 6-month-old leaves			3–6-month-old leaves			Over 6-month-old leaves			3–6-month-old leaves					
		Zn	Cu	Mn	Zn	Cu	Mn	Zn	Cu	Mn	Zn	Cu	Mn	Zn	Cu	Mn	Zn	Cu	Mn	Zn	Cu	Mn
1	A-46	30.26	7.21	520.18	34.58	15.21	410.12	30.24	7.31	530.12	35.00	14.54	425.51	31.25	7.01	531.14	35.98	15.97	376.86	32.88	11.21	465.66
2	A-128	30.87	7.35	530.58	35.27	15.51	418.32	30.84	7.46	540.72	35.70	14.83	434.02	31.88	7.15	541.76	36.70	16.29	384.40	33.54	11.43	474.97
3	B-46	31.17	7.43	535.79	35.62	15.67	422.42	31.15	7.53	546.02	36.05	14.98	438.28	32.19	7.22	547.07	37.06	16.451	388.17	33.87	11.55	479.63
4	C-38	31.79	7.58	546.51	36.33	15.98	430.87	31.77	7.68	556.54	36.77	15.28	447.05	32.83	7.36	558.01	37.80	16.78	395.93	34.55	11.78	489.15
5	D-2	32.11	7.65	551.86	36.69	16.14	435.09	32.08	7.76	562.40	37.13	15.43	451.43	33.16	7.44	563.48	38.17	16.94	399.82	34.89	11.89	494.01
6	D-26	32.75	7.80	562.90	37.42	16.46	443.79	32.72	7.92	573.65	37.87	15.74	460.46	33.82	7.59	574.75	38.93	17.28	407.82	35.59	12.13	503.90
7	D-33	33.07	7.88	568.42	37.79	16.62	448.14	33.04	7.99	579.27	38.24	15.89	464.97	34.15	7.66	580.38	39.32	17.45	411.81	35.94	12.25	508.83
8	D-81	33.73	8.04	579.79	38.55	16.95	457.10	33.70	8.15	590.86	39.00	16.21	474.27	34.83	7.81	591.99	40.11	17.80	420.05	36.65	12.49	519.01
9	E-43	34.06	8.12	585.47	38.92	17.12	461.58	34.03	8.23	596.65	39.39	16.37	478.92	35.17	7.89	597.79	40.50	17.97	424.16	37.01	12.62	524.10
10	F-56	34.74	8.28	597.18	39.70	17.46	470.81	34.71	8.39	608.58	40.18	16.70	488.50	35.87	8.05	609.75	41.31	18.33	432.64	37.75	12.87	534.58
Mean		32.46	7.73	557.87	37.09	16.31	439.82	32.43	7.84	568.48	37.53	15.60	456.34	33.52	7.52	569.61	38.59	17.13	404.17	35.27	12.02	499.38

Table 4: Effect of canopy height and age on jack fruit leaf total iron and boron content (ppm) in during Pre-monsoon (April-June 2021)

S. No	Trees	Upper canopy				Central canopy				Lower canopy				Mean	
		Over 6-month-old leaves		3–6-month-old leaves		Over 6-month-old leaves		3–6-month-old leaves		Over 6-month-old leaves		3–6-month-old leaves			
		Fe	B	Fe	B	Fe	B	Fe	B	Fe	B	Fe	B	Fe	B
1	A-46	91.26	40.44	92.56	36.51	95.46	43.56	96.54	36.78	110.10	43.15	92.56	34.56	96.41	39.17
2	A-128	93.09	41.25	94.41	36.91	97.37	44.43	98.88	37.52	112.30	44.01	94.41	35.25	98.41	39.90
3	B-46	94.00	41.65	95.34	37.28	98.32	44.87	99.85	37.88	113.40	44.44	95.34	35.60	99.38	40.29
4	C-38	89.30	42.48	92.39	38.03	93.40	45.77	96.76	38.64	107.73	45.33	90.57	36.31	95.03	41.09
5	D-2	95.25	42.98	98.20	38.40	100.29	46.22	102.85	39.02	115.67	45.77	97.25	36.67	101.59	41.51
6	D-26	97.16	43.76	100.16	39.17	101.27	46.69	104.91	39.80	116.80	46.69	98.20	37.40	103.08	42.25
7	D-33	98.11	44.19	101.15	39.55	103.30	47.14	105.94	40.19	119.14	47.14	100.16	37.77	104.63	42.66
8	D-81	100.07	45.07	103.17	40.34	104.31	48.08	108.06	40.99	120.30	48.08	101.15	38.53	106.18	43.52
9	E-43	101.05	45.52	104.18	40.74	106.40	48.55	109.12	41.40	122.71	48.55	103.17	38.90	107.77	43.94
10	F-56	103.07	46.43	106.26	41.55	107.44	49.52	111.30	42.23	123.91	49.52	104.18	39.68	109.36	44.82
Mean		96.24	43.38	98.78	38.85	100.76	46.48	103.42	39.45	116.21	46.27	97.70	37.07	102.18	41.91

Table 5: Mean, range and S.D of leaf nutrient concentration of jack fruit in southwest monsoon and north east monsoon season

	July-September2020											October-December2020										
	Macronutrients (%)						Micronutrients (ppm)					Macronutrients (%)						Micronutrients (ppm)				
	N	P	K	Ca	Mg	S	Zn	Cu	Mn	Fe	B	N	P	K	Ca	Mg	S	Zn	Cu	Mn	Fe	B
Mean	2.78	0.19	2.25	1.23	0.57	0.22	46.35	15.56	518.68	131.15	57.91	2.78	0.19	2.25	1.23	0.57	0.22	46.35	15.56	518.68	131.15	57.91
Min	2.59	0.14	1.80	0.99	0.21	0.07	41.69	13.48	397.24	119.34	49.39	2.59	0.14	1.80	0.99	0.21	0.07	41.69	13.48	397.24	119.34	49.39
Max	2.99	0.24	2.45	1.50	0.49	0.27	49.69	17.63	633.15	144.67	66.57	2.99	0.24	2.45	1.50	0.49	0.27	49.69	17.63	633.15	144.67	66.57
SD	0.20	0.05	0.33	0.26	0.19	0.10	4.02	2.08	117.97	12.67	8.59	0.20	0.05	0.33	0.26	0.19	0.10	4.02	2.08	117.97	12.67	8.59

Table 6: Mean, range and S.D of leaf nutrient concentration of jack fruit in dry period and pre-monsoon season

	Dry period (January-March 2021)											Pre-monsoon (April-June2021)										
	Macronutrients (%)						Micronutrients (ppm)					Macronutrients (%)						Micronutrients (ppm)				
	N	P	K	Ca	Mg	S	Zn	Cu	Mn	Fe	B	N	P	K	Ca	Mg	S	Zn	Cu	Mn	Fe	B
Mean	2.35	0.15	1.20	0.47	0.07	0.16	30.73	3.55	108.86	83.03	23.75	2.48	0.18	1.81	0.86	0.28	0.22	35.27	12.02	499.38	102.18	41.91
Min	2.14	0.14	0.96	0.38	0.01	0.15	27.59	2.28	92.59	74.19	17.54	2.21	0.12	1.29	0.71	0.15	0.17	30.24	7.01	410.12	91.26	34.56
Max	2.49	0.16	1.35	0.56	0.13	0.16	35.02	5.67	127.54	93.54	30.47	2.78	0.24	2.56	1.15	0.45	0.24	41.31	18.33	609.75	123.91	49.52
SD	0.18	0.01	0.20	0.09	0.06	0.01	3.73	1.71	17.49	9.69	6.47	0.28	0.06	0.63	0.22	0.15	0.03	5.54	5.67	100.00	16.62	7.48

Table 7: Standard of leaf nutrient concentrations of jackfruit for getting optimum yield

Nutrient	Deficiency	Low	Optimum	High	Excess
Total N %	<2.24	2.24 – 2.41	2.42 – 2.76	2.77 – 2.94	>2.94
Total P %	<0.14	0.14 – 0.15	0.16 – 0.18	0.19 – 0.20	>0.20
Total K %	<0.96	0.96 – 1.37	1.38 – 2.24	2.25 – 2.66	>2.66
Total Ca %	<0.47	0.47 – 0.74	0.75 – 1.31	1.32 – 1.59	>1.59
Total Mg %	<0.01	0.01 – 0.14	0.15 – 0.41	0.42 – 0.55	>0.55
Total S %	<0.15	0.15 – 0.16	0.17 – 0.23	0.24 – 0.25	>0.25
Total Zn (ppm)	<27.15	27.15 – 32.72	32.73 -43.87	43.88 – 49.45	>49.45
Total Cu (ppm)	<2.24	2.24 – 6.29	6.30 – 14.40	14.41- 18.46	>18.46
Total Mn (ppm)	<94.59	94.59 – 239.70	239.71 – 529.95	529.96 – 675.07	>675.07
Total Fe (ppm)	<74.19	74.19 – 88.44	88.45 – 116.99	117.00 – 131.25	>131.25
Total B (ppm)	<23.42	23.42 – 34.03	34.04 – 55.26	55.27 – 65.88	>65.88

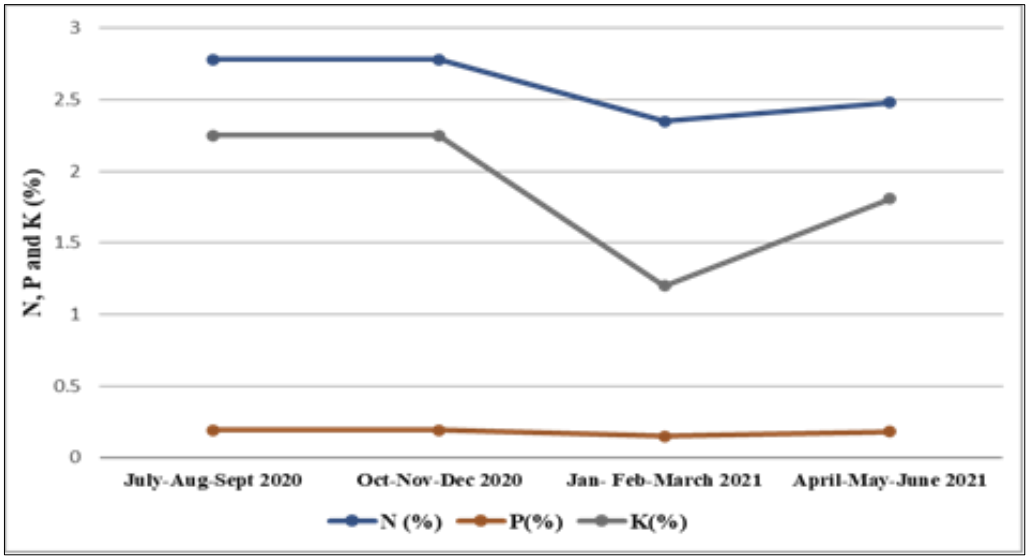

Fig 1: Seasonal changes in leaf N, P and K concentration in jackfruit during annual growth 2020-2021

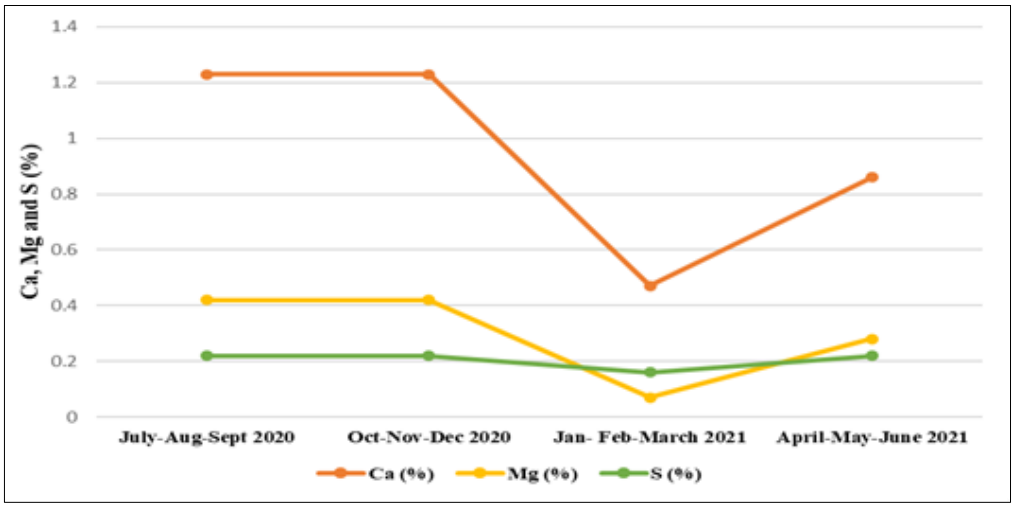

Fig 2: Seasonal changes in leaf Ca, Mg and S concentration in jackfruit during annual growth 2020-2021

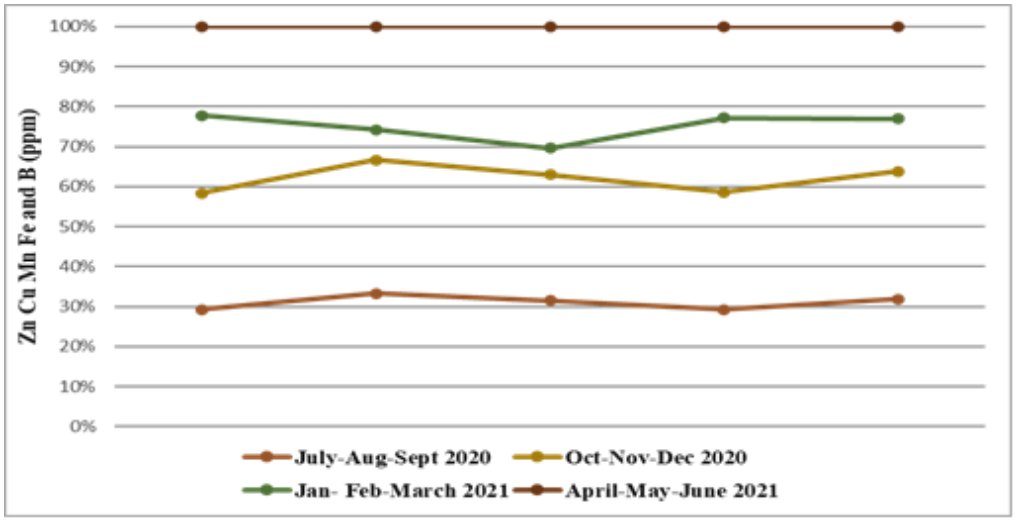

Fig. 3: Seasonal changes in leaf Zn, Cu, Mn Fe and B concentration in jackfruit during annual growth 2020-2022

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Conclusion
This study assessed the jackfruit sample technique, including canopy height, leaf age, and sampling period, in order to assess the nutritional status of the jackfruit. The stable leaf sample intra-canopy was 3-6 month old leaves from the central canopy, and the stable leaf sampling period was April-June. This research also determined the optimal leaf nutrition amounts. The findings of the study could be utilized to diagnose jackfruit nutritional status and help to plan fertilizer programs.

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