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Research Article

Comprehensive study on understanding the incidence of Yellow Leaf Disease in Dakshina Kannada districts of Karnataka

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ABSTRACT

Yellow Leaf Disease (YLD) poses a significant threat to arecanut cultivation, particularly in regions like Dakshina Kannada district, Karnataka, India. This study presents a comprehensive survey conducted across three taluks - Puttur, Bantwal, and Sullia to assess the incidence and intensity of YLD. In Puttur Taluk, disease incidence ranged widely from 0 to 100 percent, with Bajathoor and Savanur exhibiting the highest rates. Similar patterns were observed in disease intensity. Conversely, certain villages displayed no YLD intensity, suggesting potential areas for further investigation into disease resistance mechanisms. In Bantwal Taluk, varying levels of incidence and intensity were observed, emphasizing the localized nature of disease dynamics. In Sullia Taluk, a broad spectrum of vulnerability was noted, with Sampaje recording the highest incidence and intensity. However, several villages showed no observable disease incidence, indicating areas of resilience or effective management practices. Overall, the survey underscores the need for targeted interventions to mitigate YLD's impact on arecanut cultivation. These interventions should encompass cultural practices, chemical control measures, breeding for disease resistance, and integrated pest management. Additionally, capacity-building initiatives and farmer education programs are essential for enhancing awareness and adoption of best practices. Addressing the challenges posed by YLD requires a collaborative effort from all stakeholders, guided by scientific research and tailored to local farming communities' specific needs. Through collective action, the resilience of arecanut cultivation in Dakshina Kannada district and beyond can be ensured.

KEY WORDS: Arecanut; Yellow Leaf Disease; Survey; Dakshina Kannada; Incidence; Severity

1. Introduction

Arecanut plays a vital role in cultural and social customs, especially in South and Southeast Asian countries like India, Bangladesh, Myanmar, Thailand and Indonesia. It is commonly offered as a gesture of hospitality, friendship, or respect during social gatherings, ceremonies, and religious rituals. It is often chewed along with betel leaf and slaked lime as a traditional stimulant, particularly in cultural and social contexts (Raghavan and Baruah, 1958). This practice, known as betel chewing, is deeply ingrained in the cultural fabric of many communities and is believed to have stimulant, digestive, and medicinal properties.

Arecanut cultivation is a significant source of livelihood for millions of farmers in regions where it is grown. The crop contributes substantially to the agricultural economy of countries like India, Indonesia, Sri Lanka, and Papua New Guinea. It provides employment opportunities not only in cultivation but also in processing, transportation, and marketing sectors. It is rich in nutrients and bioactive compounds. It contains carbohydrates, proteins, fats, vitamins (particularly vitamin E),

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and minerals like calcium, phosphorus, and iron. However, excessive consumption of arecanut, especially when chewed with other additives like tobacco, can lead to adverse health effects. However, its use in traditional medicine should be approached with caution due to potential health risks associated with excessive consumption. Industrial Uses: Apart from its traditional and cultural significance, arecanut finds applications in various industries. Its extracts are used in the manufacture of dyes, tannins and chemicals. Additionally, husks are utilized for making handicrafts, biofuels, and animal feed.

India is the largest producer and consumer of arecanut in the world, with a total area of 730.82 thousand ha and production of 1208.93 thousand tonnes and productivity of 1654 kg/ha. In Karnataka, 500 thousand ha of area is under arecanut cultivation and production of 950 thousand tonnes with productivity of 1900 kg/ha of nuts were produced during 2020-21 (DASD, 2021). Arecanut, being a major commercial crop in several tropical regions, is susceptible to various diseases that can adversely affect its growth, yield, and quality. Some of the common diseases of arecanut are Yellow Leaf Disease (Phytoplasma); Leaf spot and Inflorescence die back (*Colletotrichum gleosporoides*); Fruit Rot (*Phytophthora arecae*); Leaf Blight (*Pestalotiopsis palmarum*); Bud Rot (*Phytophthora palmivora*) and Foot rot (*Ganoderma lucidum*)

Yellow Leaf Disease (YLD) of arecanut is a significant concern in regions where arecanut cultivation is prominent, such as parts of India, including the Dakshina Kannada district in Karnataka (Hiremata *et al*., 2020). This disease was first reported by Nambiar, 1949, caused by various primarily by phytoplasma, manifests as yellowing of the leaves and leading to considerable yield losses if not managed effectively. Symptoms includes yellowing of leaves, often starts from the lower leaves and gradually progresses upwards. Infected leaves may exhibit yellowing along the margins or throughout the leaf surface, with veins retaining green color initially (Chowdappa *et al*., 1995). As the disease advances, affected leaves may dry up and drop prematurely, leading to defoliation and reduced crown region.

YLD is caused by phytoplasma (a type of bacteria-like organism). Transmission of the disease is primarily by insect vectors, plant hoppers (*Proutista moesta*). YLD significantly reduce the yield and quality of arecanut. Severe infections can lead to stunted growth, reduced nut size and decreased nut production, ultimately affecting the economic viability of arecanut cultivation. Managing Yellow Leaf Disease requires an integrated approach that combines cultural, chemical and biological control measures. These may include the use of disease-resistant varieties, regular monitoring and early detection of symptoms, pruning and removal of infected plant parts and adoption of good agricultural practices to minimize disease spread. Ongoing research and extension efforts are focused on understanding the severity and spread of disease from endemic regions to non-traditional areas. Collaboration between researchers, extension agents and farmers are essential for disseminating information for implementing effective disease management strategies. Keeping all these points in view, the study has been carried out and implemented.

2. Materials and Methods

An intensive roving survey was carried out during 2021-22 to assess the incidence and intensity of

yellow leaf disease in major arecanut growing regions of Karnataka *viz.*, Putturu, Bantwal and Sullia taluks of Chikkamagaluru district. At each location five fields were selected randomly and per cent disease incidence was calculated by observing twenty five plants per garden and the intensity was calculated by selecting five plants at each garden by following scoring system (Table 1a, 1b, 1c) given by George *et al.* (1980).

Table 1a: Intensity of yellow leaf disease of arecanut - Scoring for yellowing (Y)

Sl. No.	Features	Scoring
1	Healthy	0
2	Tip yellowing upto 25 % of leaflets	1
3	Tip yellowing upto 50 % of leaflets	2
4	Tip yellowing more than 50 % + marginal yellowing upto 25 %	3
5	Tip yellowing in full + marginal yellowing upto 50 % + Complete yellowing upto 25 %	4
6	Tip yellowing in full + marginal yellowing upto more than 50 % + Complete yellowing upto 50 %	5
7	Tip yellowing in full + marginal yellowing upto more than 50 % + Complete yellowing in full (mild)	6
8	Complete yellowing in full (severe)	7

Table 1b: Intensity of yellow leaf disease of arecanut - Scoring for Necrosis (N)

Sl. No.	Features	Scoring
1	Healthy	0
2	Necrosis upto 50 % of the leaflets	1
3	Necrosis in more than 50% of the leaflets	2

Table 1c: Intensity of yellow leaf disease of arecanut - Scoring for crown size reduction (R)

Sl. No.	Features	Scoring
1	Healthy	0
2	Reduction in size of younger leaves	0.5
3	Reduction in size of younger leaves and stem tapering	1

2.1 Estimation of percent disease incidence

The percent disease incidence was assessed by recording the number of plants showing disease symptoms, out of the total number of plants examined.

Symptoms: Rawther (1976) recorded the characteristic symptoms of the disease as

a. Inter-venial foliar yellowing starting from the tips of leaflets in two to three leaves of the outermost whorl (Y).
b. Necrosis of the leaflets and eventually dry up (N).
c. In advanced stage, leaves are reduced in size, become stiff and pointed, closely bunched and abnormally puckered (R).

Based on the standard symptoms observed during survey, percent disease incidence and intensity was calculated.

The percentage of disease incidence was calculated by using the following formula.

$$\text{Disease Incidence (DI \%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants examined}} \times 100$$

2.2 Assessment for the intensity of yellow leaf disease of arecanut

Mean of twenty-five plants were used to determine the intensity scoring by using formula given below by George *et al*. (1980).

Scoring system to assess intensity in yellow leaf affected gardens

Intensity = ((Y+N)/L+ R) × 10

Where,
Y = Total scoring for yellowing of the leaves (0-7)
N = Scoring for the necrosis of the leaves (0-2)
R=Scoring for reduction in size of the crown (0-1)
L = Half the number of leaves in the crown

3. Results and Discussion

3.1 Symptomology of the yellow leaf disease of arecanut

Symptom appearance and its presence on the plant can be seen across all the three seasons in a year. However, conspicuous symptoms of YLD were well pronounced immediately after the onset of South-West monsoon rains especially during August-November where, its cessation and maintaining of the green colour by the younger leaves is commonly observed in majority of gardens. Characteristics of yellowing starts from the tip of the leaflets of second or third fronds of the outer most whorls of the palm. Later on yellowing gradually extends to the middle of the lamina showing typical demarcation of yellow and green parallel bands on both sides of the midrib of the leaflets. The leaves become stiff and pointed, closely bunched and abnormally puckered. As the disease progresses, yellowing extends to the whole lamina and leaf tips become necrotic and dries up during summer leaving the leaf stalk green. Subsequently, symptoms appeared on both mature and immature nuts wherein, kernel size gets reduced, discoloration and rotting of kernels and non production of inflorescence and if produced, drying up of the entire inflorescence was also observed. At the advanced stage, crown size reduction, reduction in the inter nodal length and tapering of the stem followed by decapitation of the entire crown leaving a bare trunk were conspicuous. Affected plant roots also exhibit brown to black colour discoloration (Fig.1). By observing these symptoms, incidence and intensity of palms were calculated.

Fig. 1: Typical Symptoms of yellow leaf disease of Arecanut

3.2 Survey for the incidence and intensity of yellow leaf disease of arecanut in Chikkamagaluru district

Arecanut is a cornerstone of agriculture in Dakshina Kannada district, Karnataka, India. However, the cultivation of this economically significant crop faces substantial challenges due to various diseases, with Yellow Leaf Disease (YLD) being one of the most prevalent and detrimental.

Understanding the extent and severity of YLD across different taluks and districts is paramount for effective disease management and sustainable arecanut cultivation practices. This study presents

the comprehensive findings of a survey conducted to assess YLD incidence and intensity in three taluks of Dakshina Kannada district was represented in **Table 2**.

In Puttur Taluk, the survey unveiled a wide spectrum of disease incidence, ranging from 0 to 100 percent, indicating varied vulnerability levels among different areas. Notably, Bajathoor exhibited the highest disease incidence at 100 percent, closely followed by Savanur at 95 percent. Concurrently, disease intensity exhibited a similar pattern, ranging from 0 to 97.50 percent, with Bajathoor recording the highest intensity at 97.50 percent, trailed closely by Savanur at 92.50 percent. Remarkably, certain villages such as Barike, Navoor, Nekkare, Kochhi, and Punchatharu displayed no intensity of YLD, signaling potential areas for further study on disease resistance mechanisms.

The survey in Bantwal Taluk uncovered disease incidence varying from 0 to 40.00 percent, with corresponding intensity levels ranging from 0 to 30.00 percent. Notably, Urimajalu emerged as the village with the highest disease incidence at 50.00 percent, closely followed by Ananthady at 40.00 percent. However, intensity levels displayed a different trend, with Urimajalu recording the highest intensity at 30.00 percent, followed by Ananthady at 27.50 percent. These findings underscore the localized nature of disease dynamics within the taluk and highlight the need for tailored management strategies.

In Sullia Taluk, disease incidence spanned from 0 to 100.00 percent, showcasing a broad spectrum of vulnerability across surveyed areas. Sampaje registered the highest disease incidence at 100.00 percent, accompanied by a significant intensity of 95.00 percent. Additionally, villages such as Panja, Alletti, and Guttigar exhibited a disease incidence of 95.00 percent, emphasizing the widespread nature of YLD within the taluk. Conversely, several villages including Yenekallu, Parla, Nadugallu, Balladi, Panjipalla, and Sannara displayed no observable disease incidence, suggesting potential areas of resilience or effective disease management practices.

4. Conclusion

The findings of this survey shed light on the significant challenges posed by Yellow Leaf Disease (YLD) in arecanut cultivation across the taluks of Puttur, Bantwal, and Sullia in Dakshina Kannada district, Karnataka. The survey revealed a diverse landscape of YLD incidence and intensity across different areas within the surveyed taluks.

In Puttur Taluk, a wide spectrum of disease incidence ranging from 0 to 100 percent was observed, with Bajathoor and Savanur emerging as the areas with the highest incidence rates. Similarly, disease intensity exhibited a similar pattern, with Bajathoor and Savanur recording the highest intensities. Notably, certain villages displayed no intensity of YLD, indicating potential areas for further investigation into disease resistance mechanisms.

In Bantwal Taluk, the survey uncovered varying levels of disease incidence and intensity, highlighting the localized nature of disease dynamics within the taluk. Urimajalu and Ananthady emerged as the villages with the highest disease incidence, with intensity levels reflecting a different trend. These findings underscore the need for tailored management strategies to address the localized nature of YLD outbreaks.

Table 2: Prevalence and severity of yellow leaf disease across different areca nut plantations in Dakshina Kannada district

District	Taluk	Village	Latitude	Longitude	Variety	Age of the crop	Area cultivated (ha)	Other Pests, diseases	Per cent Disease Incidence	Intensity (%)
Daksihna Kannada	Puttur	Barike	12.7939	75.4157	Mangala	28	0.08	LS, RR	0.00	0.00
		Navoor	12.7064	75.3870	Mangala	20	0.45	LS, SI	0.00	0.00
		Idyadi	12.7593	75.3075	Mangala	50	1.29	ND	10.00	6.00
		Panemajalu	12.7497	75.3025	South Kanara	45	0.55	LS, ND	10.00	14.00
		Golitottu	12.8478	75.3591	Mangala	28	0.61	LS	10.00	0.00
		Kumla	12.8544	75.3569	Mangala	30	1.34	ND	50.00	52.50
		Kuchila	12.8629	75.3637	Mangala	35	0.08	LS, RR	10.00	12.00
		Nekkare	12.8511	75.3664	Mangala	45	0.40	LS	0.00	0.00
		Kochhi	12.8487	75.3744	Mangala	56	0.08	ND	0.00	0.00
		Haradi	12.7736	75.1963	South Kanara	34	0.49	LS, SI	65.00	55.00
		Bajathoor	12.8416	75.2957	South Kanara	30	0.49	LS, CC	100.00	97.50
		Madody	12.7129	75.3586	South Kanara	45	0.40	LS	85.00	87.50
		Savanur	12.7417	75.3083	South Kanara	38	0.49	SI	95.00	92.50
		Punchatharu	12.7096	75.3815	South Kanara	35	0.13	LS	0.00	0.00
		Mogaru	12.9619	74.9694	South Kanara	50	0.13	LS, RR	85.00	67.50
		Kodaka	12.8782	75.4191	Mangala	56	1.36	ND	10.00	12.00
		Kovadi	12.8786	75.4192	Mangala	35	1.69	RR	10.00	0.00
		Uruvalu	12.8667	75.2848	Mangala	34	1.23	LS, SI	10.00	25.00
		Ilanthila	12.8583	75.2769	Mangala	32	0.43	ND	16.00	28.00
		Marakkada	12.7318	75.3663	Mangala	35	0.12	SI	23.00	45.00
		Kaniyoor	12.7165	75.3678	Mangala	43	0.87	ND	14.00	35.00
		Munur palike	12.8765	75.3550	Mangala	51	0.77	RG	17.50	43.00
		Upparapalike	12.8557	75.3748	Mangala	28	0.34	SI	8.00	25.00
		Alanthya	12.8272	75.3602	Mangala	26	0.32	SI, RG	6.00	21.00
		Shirady	12.8270	75.5303	Mangala	41	0.12	ND	2.00	15.00

*CC-Crown chocking, QW-Quick wilt of pepper, LS-Leaf spot, RR-Root rot, RG-Root grub, BR-Bud rot, ND-Nut drop, KR-Kole roga, SI-Sucking insects

Contd…

Table 2: Prevalence and severity of yellow leaf disease across different areca nut plantations in Dakshina Kannada district (Contd..)

District	Taluk	Village	Latitude	Longitude	Variety	Age of the crop	Area cultivated (ha)	Other Pests, diseases	Per cent Disease Incidence	Intensity (%)
Daksihna Kannada	Bantwal	Mithur	12.7831	75.1400	Mangala	25	1.69	LS, RG	0.00	0.00
		Surya	12.7889	75.1304	Mangala	30	1.69	LS	0.00	0.00
		Netlamudnur	12.7927	75.1310	Mangala	35	0.12	KR, SI	0.00	0.00
		Karinka	12.7919	75.1172	Mangala	28	0.06	LS	10.00	6.00
		Nadumane	12.7939	75.1131	Mangala	39	0.69	LS, RG	0.00	0.00
		Irandoor	12.7897	75.1102	Mangala	45	0.48	LS	30.00	14.00
		Vittalpadanur	12.7791	75.1048	Inter Mangala	36	1.77	LS, SI	0.00	0.00
		Naithottu	12.7960	75.1070	Inter Mangala	45	1.77	ND, RR	10.00	6.00
		Ananthady	12.8022	75.1152	Inter Mangala	50	1.01	LS	40.00	27.50
		Sankesha	12.8035	75.1095	Inter Mangala	55	1.13	LS, RG	0.00	0.00
		Hancharike	13.4575	75.2484	Inter Mangala	45	0.40	ND	10.00	6.00
		Badakodi	12.7191	75.1272	Inter Mangala	65	0.81	SI, RG	0.00	0.00
		Kodimbala	12.7215	75.4752	Mangala	40	0.61	LS, RR	0.00	0.00
		Urimajalu	12.7842	75.1398	Mangala	34	0.81	RG	50.00	30.00
		Kesarukodige	13.4676	75.2533	Mangala	28	0.96	LS, SI	0.00	0.00
		Punja	12.6786	75.4724	Mangala	25	1.77	LS, RG	0.00	0.00
		Addabailu	12.6785	75.4919	Mangala	20	0.81	ND	0.00	0.00
		Kukkipadi	12.9754	75.0691	Mangala	25	0.21	LS, ND	0.00	0.00
		Kedila	12.8064	75.1619	Mangala	35	0.28	LS, RG	2.00	12.00
		Peraje	12.8208	75.1481	Mangala	34	0.19	ND	2.00	10.00
		Rayee	12.9464	75.0554	Mangala	45	1.12	ND	0.00	0.00
		Sarapady	12.8790	75.1276	Mangala	38	1.25	RG, ND	0.00	0.00
		Budoil	12.9483	75.0721	Mangala	28	0.76	ND	2.00	10.00
		Chennaithodi	12.9718	75.0995	Mangala	23	1.23	LS, ND	0.00	0.00
		Mudanadugodu	12.9090	75.0705	Mangala	43	1.40	RG	0.00	0.00

*CC-Crown chocking, QW-Quick wilt of pepper, LS-Leaf spot, RR-Root rot, RG-Root grub, BR-Bud rot, ND-Nut drop, KR-Kole roga, SI-Sucking insects

Contd…

Table 2: Prevalence and severity of yellow leaf disease across different areca nut plantations in Dakshina Kannada district (Contd..)

District	Taluk	Village	Latitude	Longitude	Variety	Age of the crop	Area cultivated (ha)	Other Pests, diseases	Per cent Disease Incidence	Intensity (%)
Daksihna Kannada	Sullia	Yenekallu	12.6738	75.5649	Mangala	25	0.81	RR	0.00	0.00
		MuthlajeBailu	12.6751	75.5655	Mangala	30	0.81	LS, RG	10.00	17.00
		Pundigadde	12.6614	75.5612	Mangala	38	0.89	ND	5.00	10.00
		Parla	12.6732	75.5547	Mangala	45	1.77	ND, RR	0.00	0.00
		Nadugallu	12.6455	75.5661	Inter Mangala	23	0.81	LS	0.00	0.00
		Balladi	12.6693	75.5509	Inter Mangala	45	0.49	LS	0.00	0.00
		Halemajalu	12.6431	75.5506	Inter Mangala	47	0.12	ND, KR	12.00	16.00
		Panjipalla	12.6381	75.5407	Mangala	50	0.15	LS	0.00	0.00
		Mettinadka	12.6190	75.5478	Inter Mangala	54	0.28	LS	20.00	26.00
		Salthadi	12.6163	75.5454	Mangala	34	0.15	LS, KR	10.00	12.00
		Santhinagar	12.6907	75.4080	Mangala	33	0.81	LS, RG	30.00	29.00
		Budengi	12.6889	75.5465	Mangala	45	0.51	ND	40.00	37.00
		Sannara	12.6954	75.5551	Mangala	27	0.18	LS, RR	0.00	0.00
		Sampaje	12.4938	75.5669	Mangala	65	1.23	SI	100.00	92.00
		Panja	12.6801	75.4742	Mangala	28	0.76	LS, RG	95.00	87.50
		Harihara pallathodka	12.6043	75.6108	Mangala	56	0.92	LS	27.00	32.00
		Adyadka	12.4863	75.4768	Mangala	34	1.17	LS, SI	79.00	52.50
		Aranthodu	12.5157	75.4636	Mangala	51	0.33	LS, ND	91.00	61.00
		Guttigar	12.6304	75.5261	Mangala	35	0.54	RG	95.00	63.00
		Kollamogru	12.5758	75.6109	Mangala	45	0.12	LS, RG	82.00	67.00
		Madapadi	12.5791	75.5381	Mangala	56	0.91	RG	87.00	63.00
		Murulya	12.6856	75.4187	Mangala	67	0.43	LS, SI	84.00	70.00
		Marakanja	12.5630	75.5059	Mangala	29	0.33	ND	89.00	80.00
		Alletti	12.5330	75.3747	Mangala	35	0.32	LS	95.00	80.00
		Morangallu H. C	12.5345	75.3843	Mangala	52	1.30	SI, RG	83.00	70.00

*CC-Crown chocking, QW-Quick wilt of pepper, LS-Leaf spot, RR-Root rot, RG-Root grub, BR-Bud rot, ND-Nut drop, KR-Kole roga, SI-Sucking insects

In Sullia Taluk, the survey showcased a broad spectrum of vulnerability to YLD across surveyed areas. Sampaje recorded the highest disease incidence and intensity, emphasizing the widespread nature of YLD within the taluk. However, several villages displayed no observable disease incidence, suggesting potential areas of resilience or effective disease management practices.

Overall, the comprehensive findings of this survey underscore the importance of understanding the extent and severity of YLD for effective disease management and sustainable arecanut cultivation practices. By identifying areas of high vulnerability and localized disease hotspots, this study provides valuable insights for targeted interventions aimed at mitigating the impact of YLD on arecanut cultivation in Dakshina Kannada district. These strategies should encompass a combination of cultural practices, chemical control measures, breeding for disease resistance, and integrated pest management approaches. Additionally, capacity-building initiatives and farmer education programs are crucial for enhancing awareness and adoption of best practices to mitigate the impact of YLD and ensure the resilience of arecanut cultivation in the region. In conclusion, addressing the challenges posed by YLD requires a concerted effort from all stakeholders, guided by scientific research and tailored to the specific needs of the local farming communities. Through collective action and sustained commitment, we can safeguard the future of arecanut cultivation in Dakshina Kannada district and beyond.

The results indicate the probable association of various soil and environmental factors contributing for highest disease incidence in these districts. As the arecanut crop is cultivated from centuries its extensive cultivation especially in hilly tracts which receives an average annual rainfall of 3573 mm during South-West monsoon hastens the intensity of the disease to be endemic in nature. These results were in accordance with the results obtained by Krishnamurthy and Vajranabhaiah (2000) who reported the 24.4 to 40.00 per cent disease incidence in Sringeri and coastal zones (Sampaje belt) of Karnataka.

5. Conflict of interest

The authors have no conflict of interest.

6. References

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