E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(3): 19-22
Received: 27-12-2023
Accepted: 30-01-2024

Ranjini TN
Scientist, Division of Crop Improvement, ICAR-CPCRI, Kasaragod, Kerala, India

Niral V
Head, Division of Crop Improvement, ICAR-CPCRI, Kasaragod, Kerala, India

Surekha
Senior Scientist, Division of Crop Production, ICAR-CPCRI, Kasaragod, Kerala, India

Panjavarnam G
Scientist, Division of Crop Production, ICAR-CPCRI, Kasaragod, Kerala, India

Gayathri UK
Division of Crop Improvement, ICAR-CPCRI, Kasaragod, Kerala, India

Corresponding Author:
Ranjini TN
Scientist, Division of Crop Improvement, ICAR-CPCRI, Kasaragod, Kerala, India

Diversity and dynamics of weed flora in coconut gardens with varied spacings along the west coast of Kerala, India

Ranjini TN, Niral V, Surekha, Panjavarnam G and Gayathri UK

DOI: https://doi.org/10.33545/2618060X.2024.v7.i3Sa.372

Abstract
The study at ICAR-CPCRI, Kasaragod, Kerala investigates weed flora and ground vegetation structure in a coconut garden with varied spacings, focusing on documenting weed diversity and density. Three coconut plots, with spacings of 4x4 m, 6x6 m, and a standard of 7.5x7.5 m, were examined. Results revealed 39 plant species across 16 families. In the 4x4 m spacing plot, 26 weed species from 13 families were observed, with Amaranthaceae as the most dominant, followed by Asteraceae and Fabaceae. The average weed density was 100 plants/m^2. The 6x6m spacing plot exhibited 21 weed species from 11 families, with Poaceae dominating, followed by Asteraceae and an average weed density of 148.50 plants/m^2. The standard 7.5x7.5 m spacing plot recorded 16 weed species, with the highest belonging to the Poaceae family, followed by Malvaceae and an average weed density of 71.75 plants/m^2. While the 4x4 m spacing plot had the highest number of weed species, the 6x6m spacing plot had the highest weed density, and the 7.5x7.5m spacing plot exhibited fewer weed species and density. Variation in light penetration, shade due to spacing differences influences weed species diversity and density. This study has practical utility in adopting appropriate weed management strategies in coconut cultivation.

Keywords: *Cocos nucifera* L., coconut, plantation, weed, density, species

Introduction
Weeds, often characterized as plants in undesirable locations or unwanted plant species in agricultural fields, play a significant role in shaping the dynamics of cultivated areas. The prevalence and distribution of weed species are influenced by several factors, including the type of crops grown, cultural practices, cropping patterns, soil characteristics, moisture availability, location, and season (Sit *et al*. 2007; Shanmugam *et al*., 2016) [1, 2]. In general, weed species are considered harmful as they engage in competition with main crops for essential resources such as nutrients, light, space and water in gardens (Mathew *et al*., 2014) [3]. However, there are instances where certain weed species contribute to the well-being of crops by preventing soil erosion and maintaining optimal soil moisture levels. Some weed species also create a favorable environment for beneficial arthropods and insectivorous birds within plantations. This ecological balance aids in the suppression of pest populations, thereby enhancing overall crop yield. However, the dual nature of weeds becomes apparent as they can simultaneously limit crop choices and act as alternative hosts for pests and infections in cultivated areas (Kumari *et al*., 2018; Hendarjanti *et al*., 2022) [4, 5].

In perennial plantation crops like coconut, weed invasion adversely impacts plantation health and escalates production costs. With a 5-6 years non-productive juvenility phase, coconut palms present economic challenges for farmers. Weeds disrupt field operations and impede the establishment of coconut plantations, hindering successful growth by competing for limited resources. In coconut plantations, significant factors such as recommended doses of fertilizer application, *in situ* recycling of coconut waste biomass, summer irrigation, and intercrops create favorable conditions for the proliferation of a wide range of weeds (Surekha *et al*., 2015) [6]. Therefore, it is crucial to identify and understand the diversity of weed species in the plantation before formulating standardized weed management strategies.

Similarly, the correlation between row spacing and weed diversity is a critical aspect that requires exploration. The variance in spacing within expansive plantations directly influences micro conditions, including differences in canopy cover, light intensity, and humidity. Wider spacing provides more space between canopies, enabling increased sunlight penetration to the plantation floor. Conversely, closer spacing reduces this space, resulting in lower light intensity. Weed species exhibit varying levels of adaptation to these changing micro conditions, impacting their composition, distribution, and community structure. This adaptation disparity further influences the diversity of other associated taxa within the plantation (Satriawan and Fuady, 2019) [7]. Several studies have highlighted the significant influence of plant spacing and planting patterns on weed infestation and crop performance due to resource competition in annual crops such as Common Bean (Kebede *et al*., 2015) [8], maize (Fanadzo *et al*., 2010) [9], rice (Daba and Mekonnen, 2022) [10], finger millet (Fufa and Mariam, 2016) [11] etc. Such informations are limited in perennial crops like coconut.

Therefore, this study was conducted to comprehensively understand weed species diversity and dynamics in coconut plantations with various spacings. It seeks to reveal the correlation between coconut spacing and weed diversity, offering insights for standardized weed management strategies. The study aims to contribute to sustainable and efficient coconut cultivation.

Materials and Methods

Study location

The experiment was conducted at ICAR- Central Plantation Crops Research Institute, Kasaragod, Kerala. Geographically it is situated at 12.528 N latitude and 74.969 E longitude with an altitude of 10.7m above MSL. The climate of the district is classified as warm humid tropical. The average maximum temperature is 31.2^{0}C and minimum temperature 23.6^{0}C. The mean annual rain fall of the district is 3462 mm. Soil type is red sandy loam.

Data collection and analysis

Experiment was carried out in the three years old plantations with three different spacings of 4 x 4 m, 6 x 6 m and 7.5 x 7.5 m. Study was conducted during the month of September- October. Five quadrates of 1m^2 were placed randomly at three different plots with different spacings for the collection of weeds. Weed species within each quadrate were pooled and identified. Collected weeds were separated and grouped based on the species and family. Then using the data, Frequency, relative frequency, density, relative density, abundance, relative abundance, important value index and similarity index of weed species were calculated by the following principles of Curtis and Mclntosh (1950) [12]; Misra (1968) [13]; Mueller - Dombois and Ellenberg (1974) [14] and Batista *et al*. (2014) [15].

Frequency (%) = Total number of quadrats in which the species occur/ Total number of quadrates studied * 100.

Density (plants/m^2) = Total number of individuals of a species in all quadrates/ Total number of quadrates studied.

Abundance= Total number of individuals of a species in all quadrates / Total number of quadrates in which the species occurred.

Relative frequency= Frequency of individuals of a species/ Total density of all species x 100.

Relative density = Density of individuals of a species/ Total density of all species x 100.

Relative abundance = Abundance of individual of a species/ Total abundance of all species x 100.

Importance Value Index = Relative density + Relative frequency + Relative abundance

Similarity index was estimated using the statistical software WASP 1.0.

Results and Discussion

In three coconut plots with varying spacings of 4 x 4 m, 6 x 6 m, and 7.5 x 7.5 m, a total of 39 plant species were identified. These species, along with their respective densities, displayed variations in each sampling. They were classified into 16 families, including Amaranthaceae, Astreaceae, Commelinaceae, Cyperaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Malvaceae, Mullaginaceae, Onagraceae, Phyllanthaceae, Poaceae, Plantaginaceae, Rubiaceae, Violaceae, and Verbenaceae. Among these, 36 were dicots, and 3 were monocots (Table 1). The family Poaceae exhibited the highest number of species, with six in total, followed by Amaranthaceae, Astraceae, and Malvaceae, each with four species. Together, these families contributed to 43.58% of the weed flora in the coconut plantation. Monocots such as Poaceae, Commelinaceae, and Cyperaceae were reported in the coconut plots. Regarding the distribution pattern of weeds, six dominant species were identified, *Dactyloetenium aegyptim* (IVI of 49.30), *Cyprus rotundus* (IVI of 45.22), *Ageratum conyzoides* (IVI of 37.23), *Eleusina indica* (IVI of 34.70), *Commelina benghalensis* (IVI of 32.94), and *Phyllanthus niruri* (IVI of 32.54). These species were highlighted as the most significant in terms of abundance. The study indicated a heterogeneous distribution of species within the fields.

In the coconut plantations at Sivagangai district of Tamil Nadu, Shanmugam *et al*. (2016) [2] documented 92 weed species from 37 families. Notably, Amaranthaceae emerged as the predominant dicot family with 7 species, followed by Convolvulaceae and Euphorbiaceae (each of 6 species), while Poaceae led among monocots with 11 species. Within monocots, the study area featured only Commelinaceae, Cyperaceae, and Poaceae. Gopinathan Nair and Chami (1963) [16] supported the prevalence of, Commelinaceae, Cyperaceae, and Poaceae as major monocot families, while Asteraceae, Fabaceae, and Rubiaceae were predominant dicots in coconut gardens. Sit, *et al*. (2007) [1] observed in the Plains of the Eastern Himalayan region of West Bengal, 17 dicot families, three monocot families (Poaceae, Cyperaceae, and Araceae), and four pteridophytes in coconut plantations. Similarly, our study identified Poaceae, Commelinaceae, and Cyperaceae as major monocot weed species, while Amaranthaceae, Astraceae, and Malvaceae were prominent dicots in coconut gardens.

The coconut plot with a spacing of 4 x 4m exhibited the presence of 26 weed species from 13 distinct families, with Amaranthaceae being the most dominant, followed by Asteraceae and Fabaceae. Under 6x6m spacing, a total of 21 weed species, distributed across 11 families, were observed. In this plot, the dominant weed family was Poaceae, followed by Astraceae. For the spacing of 7.5m x 7.5m, 16 different weed species from 8 families were recorded, with the majority belonging to the Poaceae family, followed by Malvaceae. The plot with a spacing of 4 x 4 m had the highest number of species, followed by 6 x 6m and 7.5 x 7.5m (Table 1).

The highest weed density was observed in the plot with a spacing of 6 x 6m, recording a total of 148.5 plants/m^2, followed by the 4 x 4 m spacing plot with 100 plants/m^2 and the 7.5 x 7.5m^2 spaced plot with 71.75 plants/m^2. The average weed density across the three plots was 106.75 plants/m^2. In the 4 x 4 m spaced plot, the weed species *Commelina benghalensis*, commonly known as Benghal day flower or tropical spiderwort, exhibited the highest density at 15.75 plants/m^2, followed by *Phyllanthus niruri* (15.50 plants/m^2) and *Phyllanthus urinaria* (12.75 plants/m^2). In the 6 x 6 m plot, *Ageratum conyzoides* was the dominant weed species with 26.50 plants/m^2, followed by *Tridax procumbens* with 16.25 plants/m^2. In the case of the 7.5 x 7.5 m spaced plot, *Dactyloetenium aegyptium* emerged as the dominant weed species with 17.25 plants/m^2, followed by *Cyprus rotundus* (15.50 plants/m^2) (Table 1). Weed species belongs to Fabaceae family such as *Vigna spp*., *Mimosa invisa* and *Mimosa pudica* were more predominant in 4 x 4 m and 6 x 6 m spaced plots as compared to the plot of 7.5 x 7.5 m spacing.

Surekha *et al*. (2015) [6] identified 23 weed species across diverse coconut-based cropping systems, including five monocots and eighteen dicots from 13 families. The High-Density Multi-Species Cropping System (HDMSCS) plot exhibited the highest weed species count at 21, followed by Coconut with Cocoa (17), Coconut with Grass (11), and Coconut alone plot (7). The study observed variations in weed species type, frequency, abundance, and density among cropping systems. Similarly, our study noted significant differences in weed diversity and density among coconut plots, specifically highlighting that the 7.5 x 7.5m spaced plot exhibited lower weed density compared to plots with 6x6 m and 4x4 m. This variation may be attributed to the favorable microclimate in plots, resulting in higher weed numbers and density. Plots with closer spacing (4 x 4 m) reported fewer grass species and more of dicots. In line with this, Durga and Misra (2014) [17] reported that the presence of grass species was lower in plots with reduced light intensity, favoring non-grass shade-loving species. Satriawan and Fuady (2019) [7] emphasized the importance of sunlight in weed species growth in plantations. In matured oil palm plantations with higher canopy cover, *Asystasia intrusa* dominated, thriving under more shade with lower light intensity compared to immature oil palm plantations. Similarly, in our study, the plot with 4x4 m spacing, which offered less sunlight penetration and temperature, observed shade-loving species like *Commelina benghalensis*, *Phyllanthus niruri*, and *Phyllanthus urinaria* as dominant weeds, absent in the 7.5 x 7.5m spaced plot where sun-loving species like *Dactyloetenium aegyptim*, *Cyprus rotundus*, and *Eleusina indica* dominated.

Analyzing Importance Value Index (IVI) provided insights into the social status of weed species and revealed different dominant and co-dominant species among the three plots. The highest similarity index among the plots was observed between 4 x 4m spacing and 6 x 6m spaced plots at 38.23%, followed by 6 x 6m and 7.5 x 7.5m at 23.33% (Table 2). This finding aligns with observations made by Durga and Misra (2014) [17].

Table 1: Weed species, family, density, and importance value index (IVI) of underground vegetation of coconut plantation with three different spacings

SL. No.	Weed species	Family	4x4m spacing		6x6m spacing		7.5x7.5m spacing	
			Density (Plant/m^2)	IVI	Density (Plant/m^2)	IVI	Density (Plant/m^2)	IVI
1.	*Aerva lanata*	Amaranthaceae	2.25	8.74	8.25	16.75	-	-
2.	*Ageratum conyzoides*	Asteraceae	7.50	19.57	26.50	37.23	-	-
3.	*Allmania nodiflora*	Amaranthaceae	4.00	12.66	-	-	-	-
4.	*Alternanthera polygonoides*	Amaranthaceae	2.25	9.68	-	-	1.75	10.41
5.	*Alternanthera pungens*	Amaranthaceae	4.50	13.78	7.75	15.95	-	-
6.	*Brachiaria distachya*	Poaceae	-	-	2.25	8.25	2.00	14.55
7.	*Brachiaria reptans*	Poaceae	-	-	7.00	14.75	5.50	21.63
8.	*Commelina benghalensis*	Commelinaceae	15.75	32.94	10.25	18.57	-	-
9.	*Cyanotis axillaris*	Commelinaceae	4.75	14.23	2.25	7.16	-	-
10.	*Cyprus prolifer*	Cyperaceae	-	-	-	-	0.50	5.35
11.	*Cyprus rotundus*	Cyperaceae	-	-	2.50	8.58	15.50	45.22
12.	*Dactyloetenium aegyptim*	Poaceae	2.75	9.86	11.75	20.48	17.25	49.30
13.	*Echinochloa colona*	Poaceae	-	-	-	-	4.75	20.82
14.	*Eleusina indica*	Poaceae	4.75	14.34	13.75	25.54	7.75	34.70
15.	*Emilia sonchitdia*	Asteraceae	3.25	13.15	-	-	-	-
16.	*Eragrostis japonica*	Poaceae	-	-	5.00	12.82	0.75	8.70
17.	*Euphorbia hirta*	Euphorbiaceae	4.75	14.34	-	-	-	-
18.	*Hybanthus enneaspermus*	Violaceae	1.50	7.06	-	-	-	-
19.	*Leucas aspera*	Lamiaceae	-	-	-	-	2.25	12.44
20.	*Ludwigia parviflora*	Onagraceae	-	-	11.50	20.18	5.00	21.39
21.	*Ludwigis actovalvis*	Onagraceae	-	-	-	-	1.50	9.40
22.	*Mimosa invisa*	Fabaceae	0.25	2.72	-	-	0.75	9.70
23.	*Mimosa pudica*	Fabaceae	2.75	10.58	0.75	4.76	-	-
24.	*Mullugo nudicaulis*	Mullaginaceae	-	-	1.75	6.36	-	-
25.	*Mullugo pentaphylla*	Mullaginaceae	0.25	2.72	-	-	-	-
26.	*Oldenlandia corymbose*	Rubiaceae	3.50	13.08	-	-	4.25	20.53
27.	*Oldenlandia herbaceae*	Rubiaceae	-	-	-	-	2.00	11.43
28.	*Phyla nodiflora*	Verbenaceae	0.75	5.38	-	-	-	-
29.	*Phyllanthus niruri*	Phyllanthaceae	15.5	32.54	2.25	8.25	-	-
30.	*Phyllanthus urinaria*	Phyllanthaceae	12.75	28.08	-	-	-	-
31.	*Scoparia dulcis*	Plantaginaceae	0.25	2.72	-	-	-	-
32.	*Sida acuta*	Malvaceae	0.25	2.72	-	-	0.25	4.34
33.	*Sida cordata*	Malvaceae	-	-	3.25	8.76	-	-

34.	*Sida cordifolia*	Malvaceae	0.25	2.72	1.50	5.56	-	-
35.	*Sida rhombifolia*	Malvaceae	0.25	2.72	-	-	-	-
36.	*Spermacoce hispida*	Rubiaceae	0.25	2.72	6.50	13.95	-	-
37.	*Tridax procumbence*	Asteraceae	3.50	14.02	16.25	25.59	-	-
38.	*Vernonia cinerea*	Asteraceae	-	-	3.75	10.19	-	-
39.	*Vigna spp.*	Fabaceae	1.50	7.06	3.75	10.19		
	Total		100	300	148.5	300	71.75	300

Table 2: Similarity index between the coconut plots

Coconut plots	Similarity index (%)		
	4 x 4 m	6 x 6 m	7.5 x 7.5 m
4 x 4m	-	38.23	16.66
6 x 6m	-	-	23.33
7.5 x 7.5m	-	-	-

Conclusion

The current investigation has unveiled variations in both weed species abundance and diversity across coconut plantations with differing spacing. It underscores the significant impact of factors such as available space, sunlight exposure, shade, and temperature on weed diversity concerning different spacings. To the best of our knowledge, this is the first documentation of weed diversity in coconut plantations with varying spacings. The insights gained from this research can inform the development of targeted weed control strategies tailored to specific weed flora and site-specific weed management. This, in turn, facilitates more timely and effective operations, enhancing overall plantation management. Simultaneously, due consideration should be given to the utilization of certain beneficial weed species within the plantation that possess nutritional and medicinal value.

Conflict of Interests

The authors declare that there is no conflict of interest related to this article.

References

1. Sit AK, Bhattacharya M, Sarkar B, Aruachalam V. Weed floristic composition in palm gardens in plains of Eastern Himalayan region of west Bengal. Current Science. 2007;92(10):1434-1439.
2. Shanmugam S, Nagaraj R, Balamurugan S, Raja B, Rajendra K, Karmegam N. Floristic composition of weeds in coconut plantations of Sivagangai district, Tamil Nadu, Southern India. International Journal of Current Research in Biosciences and Plant Biology. 2016;3(2):121-126.
3. Mathew J, Krishnakumar V, Namboothiri CGN. Potential of native weed species as nutrient contributors of coconut garden in an Entisol. Journal of Plantation Crops. 2014;42(2):231-237.
4. Kumari PH, Meerabai G, Ratnam KV. Weed diversity in chilli fields of Kurnool district, A.P., India. International Journal of Management, Technology and Engineering. 2018;8(11):2072-2077.
5. Hendarjanti SH, Yusran AM, Ibrahim IM, Ramadhan GF, Prabowo R. Weed diversity in oil palm plantation: Benefit from the unexpected ground cover community. IOP Conf. Series: Earth and Environmental Science; c2022, p. 1-12.
6. Surekha R, Subramanian PS, Bhat R, Maheshwarappa HP. Assessment of weed species distribution in different coconut-based cropping systems. 25th Asian-Pacific Weed Science Society Conference on "Weed Science for Sustainable Agriculture, Environment and Biodiversity", Hyderabad, India During. 13-16 October, 2015, p. 403.
7. Satriawan H, Fuady. Short Communication: Analysis of weed vegetation in immature and mature oil palm plantations. Biodiversitas Journal of Biological. 2019;20(11):3292-3298.
8. Kebede M, Sharma JJ, Tana T, Nigatu L. Effect of plant spacing and weeding frequency on weed infestation, yield components and yield of common bean (*Phaseolus vulgaris* L.) in Eastern Ethiophia. East African Journal of Sciences. 2015;9(1):1-14.
9. Fanadzo M, Chiduza C, Mnkeni PN. Effect of inter row spacing and plant population on weed dynamics and maize (*Zea mays* L.) yield at Zanyokwe irrigation scheme, eastern cape, South Africa. African Journal of Agricultural Research. 2010;5(7):518-523.
10. Daba B, Mekkonnen G. Effect of row spacing and frequency of weeding on weed infestation, yield components and yield of Rice (*Oryza sativa* L.) in Beach Maji Zone, Southwestern Ethiopia. East African Journal of Sciences. 2022;9(1):1-14.
11. Fufa A, Mariam E. Weed control practices and inter row spacing influences on weed density and grain yield of finger millet in the central rift valley of ehiophia. International Journal of Research in Agriculture and Forestry. 2016;3(9):1-7.
12. Curtis JT, Mclntosh RP. The interrelationships of certain analytic and synthetic Phyto sociological characters. Ecology. 1950;31:434-455.
13. Misra R. Ecology workbook. Oxford and IBH publishing company Ltd., New Delhi; c1968, p. 244.
14. Muller D, Ellenberg H. Aims and Methods of Vegetation Ecology. John Wiley and Sons, New York; c1974, p. 66.
15. Batista K, Giacomini AA, Gerdes L, Mattos WT, Andrade JB. Phytosociological survey of weeds in aresa of crop-livestock interaction. American Journal of Plant Sciences. 2014;5:1090-1097.
16. Gopinathan Nair R, Chami PA. A survey of weeds in the fields of coconut research station, Kasaragod. Indian Coconut Journal. 1963;17:40-47.
17. Durga B, Misra MK. Flora and structure of ground vegetation of coconut plantations of Ganjam coast, Odisha, India. International Journal of Environmental Biology. 2014;4(2):127-134.