Short Scientific Report

Journal of Plantation Crops, 2014, 42(2): 231-237

Potential of native weed species as nutrient contributors of coconut garden in an Entisol

Jeena Mathew*, V. Krishnakumar and C.G. Narayanan Namboothiri

Central Plantation Crops Research Institute Regional Station, Kayamkulam, Kerala, India

(Manuscript Received: 16-07-13, Revised: 24-05-14, Accepted: 27-06-14)

Keywords: Coconut, nutrient composition, residue recycling, weeds

Weeds are plants competing with crop plants for the natural resources like soil nutrients, water and solar radiation thereby acting as a menace in agriculture through reduction in crop yield and quality. Studying weed dynamics for formulating strategies in cropping system management is therefore essential (Derksen *et al*., 2002). In the case of a perennial plantation crop like coconut, nutrient management is the core issue of concern. As the yield potential of palm increases, the quantity of nutrients removed per palm will also gradually increase. Hence, it is essential to understand the amount of nutrients that needs to be supplemented to the crop to compensate for the crop removal. Potential of common weed species for nutrient recycling have to be explored in coconut gardens for efficient utilisation of crop residues. The predominance of weed species belonging to families such as Cyperaceae and Poaceae in coconut gardens was emphasized by Nair and Chami (1963). Utilization of weed biomass in the nutrient recycling process should be done based on their ability to extract the nutrients from soil, accumulate the same in biomass and their subsequent release for plant nutrition.

From the perspective of nutrient recycling as a component of organic nutrient management, the nutrient composition and the uptake of weeds are to be studied as a means to enrich soil nutrient supplying capacity. The present study attempts to reveal the role of common weed species on the nutrient budgeting of coconut palms and their efficiency in enriching soil nutrients, thereby utilizing them as a component in the sustainable nutrient management.

The study was conducted during 2011-2012 by collecting weed species present in different coconut growing blocks of Central Plantation Crops Research Institute, Regional Station, Kayamkulam. The area is located at 9^0 8' N latitude and 76^o30' E longitude at an altitude of 3.05 m above mean sea level. Ten quadrates of 1 m^2 were fixed randomly for the collection of weed. The various species were identified and the species wise weed density (number of weeds m^{-2}) was also estimated (Table 1). The uprooted plant samples were washed with distilled water and oven dried at 65^0C till constant day weight. Samples were powdered for the estimation of various macro and micronutrients as per the standard procedures (Jackson, 1973). Nutrient uptake was calculated by multiplying the dry matter content and respective nutrient concentration. Contrast analysis with completely randomized design was done for statistically analyzing the data.

Identification and classification of weed species

Twenty one weed species were present in the coconut garden of which thirteen were annuals and eight were perennials. They belong to sixteen families *viz*., Solanaceae, Asteraceae (3 species), Capparaceae, Nyctaginaceae, Amaranthaceae (3 species), Phyllanthaceae, Verbenaceae, Convolvulaceae, Oxalidaceae, Rubiaceae, Portulacaceae (2 species), Poaceae, Lamiaceae,

*Corresponding Author: jeenu8@yahoo.com

Table1.Weeds selected for the experiment

Scientific name	Common name	Family	Weed density (No. of weeds m^{-2})	Dry matter (kg ha^{-1})
Annuals				
Cleorodendrum infortunatum	Hill glory bower	Verbenaceae	0.5	11.24
Amaranthus viridis	Slender amaranth	Amaranthaceae	0.6	7.36
Biophytum sensitivum	Little tree plant	Oxalidaceae	1.0	18.75
Ageratum conyzoides	Goat weed	Asteraceae	1.4	23.34
Solanum nigrum	Black night shade	Solanaceae	1.5	13.80
Amaranthus spinosus	Spiny amaranth	Amaranthaceae	1.5	12.99
Talinum triangulare	Surinum purslane	Portulacaceae	2.0	12.00
Phyllanthus niruri	Stone breaker	Phyllanthaceae	2.0	52.22
Boerhavia diffusa	Red spider ling	Nyctaginaceae	2.1	37.57
Cleome viscosa	Asian spider flower/tick weed	Capparaceae	4.3	53.15
Portulaca oleraceae	Common purslane	Portulacaceae	5.6	7.50
Ipomoea pes-tigridis	Tiger foot morning glory	Convolvulaceae	5.7	84.93
Boeraria hispida	Borreria	Rubiaceae	10.9	113.91
Perennials				
Sida acuta	Common wire weed	Malvaceae	0.5	41.27
Chromolena odorata	Siam weed	Asteraceae	1.0	8.56
Commelina benghalensis	Tropical spiderwort	Commelinaceae	1.8	5.04
Cynodon dactylon	Bermuda grass	Poaceae	2.0	60.00
Tridax procumbens	Coat buttons	Asteraceae	3.0	31.74
Aerva lanata	Mountain knot grass	Amaranthaceae	3.2	78.11
Hiptis suaveolens	Mint weed	Lamiaceae	3.4	57.94
Selaginella pallascens	Spike moss	Selaginellaceae	6.6	66.00

Commelinaceae, Malvaceae and Selaginellaceae. The details of the collected plant species with the corresponding density are listed in Table 1.

Composition and uptake of nutrients by common weed species in coconut garden

Major nutrients

The weed species identified were analysed for the content of major nutrients and are presented in Table 2. There was significant difference among the different plant species with respect to nitrogen content. The highest value of 4.18 per cent N was recorded by *Ipomoea pes-tigridis*. The annuals exhibited a significantly higher mean nitrogen content of 2.71 per cent compared to the perennials (1.96%). Significant difference was observed between annuals and perennials with respect to N uptake. The highest value was recorded by *Ipomoea pes-tigridis* (7.23 gm^{-2}) due to its higher dry matter production and nutrient concentration. Recycling of weed species with narrow C:N ratio can lead to the lesser microbial immobilization and faster net release of mineral nitrogen (Promsakha *et al*., 2006).

Weeds differed significantly with respect to phosphorus content and the highest concentration of 0.63 per cent was recorded by *Selaginella pallescens* which also showed significantly higher uptake (0.42 g m^{-2}).

Potassium is the key nutrient as far as the nutrition of coconut is concerned and is removed in the highest proportion from coconut production system (Nelliat, 1973). Hence, replenishment of this nutrient in the farming system is a major concern. Even though there was no significant difference between the annual and perennial groups with regard to potassium, the species within each group differed significantly. *Selaginella pallascens*, a species in between family of mosses and ferns

Table 2. Nutrient concentration of weed species with respect to primary and secondary nutrients (%)

Name of weed	Primary nutrients			Na	Secondary nutrients		
	N	P	K		Ca (mg kg^{-1})	Mg (mg kg^{-1})	S (%)
Annuals							
Solanum nigrum	1.70	0.21	3.51	0.045	85.83	34.67	0.27
Ageratum conyzoides	2.25	0.42	2.50	0.056	128.30	56.00	0.24
Boerhavia diffusa	2.77	0.24	2.24	0.012	118.10	65.67	0.36
Cleome viscosa	1.89	0.33	2.44	0.019	139.03	82.33	0.06
Amaranthus viridis	1.92	0.36	2.34	0.035	67.33	117.00	0.29
Phyllanthus niruri	2.26	0.18	0.88	0.067	104.83	209.00	0.18
Amaranthus spinosus	2.44	0.49	0.76	0.091	65.40	175.00	0.31
Cleorodendrum infortunatum	2.82	0.28	0.83	0.031	147.87	53.61	0.20
Ipomoa pes-tigrdis	4.18	0.35	0.43	0.057	72.17	45.33	0.15
Biophytum indicum	2.27	0.36	1.42	0.027	191.80	95.00	0.20
Boeraria hispida	3.62	0.26	1.38	0.084	175.33	23.67	0.09
Talinum triangulare	3.32	0.45	2.60	0.076	164.77	176.00	0.30
Portulaca oleraceae	3.73	0.56	2.51	0.022	62.93	319.67	0.27
Perennials							
Cynodon dactylon	1.43	0.31	2.15	0.390	86.20	35.14	0.11
Hiptis suaveolens	1.71	0.19	0.76	0.026	119.53	68.00	0.23
Commelina benghalensis	2.43	0.43	2.20	0.068	134.67	85.00	0.17
Chromolena odorata	2.39	0.25	1.19	0.036	112.07	23.77	0.37
Aerva lanata	1.43	0.22	2.32	0.034	74.60	42.33	0.13
Sida acuta	1.73	0.27	1.31	0.034	115.27	25.33	0.14
Selaginella pallascens	1.76	0.63	4.48	0.110	222.33	301.67	0.47
Tridax procumbens	2.79	0.28	1.59	0.038	158.47	125.33	0.17
Annuals (Mean)	2.71	0.35	1.83	0.048	117.21	111.77	0.24
Perennials (Mean)	1.96	0.32	1.99	0.092	127.89	88.32	0.20
CD (P=0.05)	0.281	0.046	0.740	0.0275	21.792	17.40	0.044

recorded significantly higher content of K (4.48%) which is four times higher than the average K content in coconut leaves (1.41%). The highest value for uptake (2.96 g m^{-2}) was also recorded by *S. pallascens*. Harrington *et al*. (2006) reported that the nutrient composition and protein content of common weeds in pasture lands were superior to pasture crops.

Halophytes are salt loving plants which can accumulate a considerable amount of sodium (Na) in their tissues. There was significant difference between the different weed species with respect to content of Na. There are several reports pertaining to the substitution of potassium (K) by Na and hence, the observation on Na accumulating capacity of common weed species gains importance. Studies have shown that under limited K supply, Na can function as its partial substitute in growth and yield of coconut (Prema *et al*., 1987) and other tropical crops (Sudharmaidevi *et al.,* 2005). The highest concentration (0.39%) and uptake (0.23 g m^{-2}) of Na was recorded by *Cynodon dactylon* which was significantly superior to all other weed species in the annual and perennial group.

With regard to calcium, *Selaginella pallascens* recorded a significantly superior value of 222.33 mg kg^{-1}. Among annuals, *Biophytum sensitivum*, a short herb with pinnate leaves, showed significantly higher uptake value (0.36 mg plant^{-1}), which was on par with the uptake by *Cleorodendrum* (0.33 mg plant^{-1}).

Table 3. Nutrient concentration of weed species with respect to micronutrients (mg kg^{-1})

Name of weed	Fe	Mn	Cu	Zn
Annuals				
Solanum nigrum	480.13	52.33	16.20	64.17
Ageratum conyzoides	710.15	42.50	24.17	56.17
Boerhavia diffusa	821.77	42.03	19.43	91.14
Cleome viscosa	510.41	53.90	47.57	41.55
Amaranthus viridis	396.17	82.40	17.37	64.67
Phyllanthus niruri	273.33	23.53	13.50	65.52
Amaranthus spinosus	709.73	34.97	18.23	74.62
Cleorodendrum infortunatum	439.18	84.03	28.43	58.27
Ipomea pes-tigridis	112.12	13.07	9.67	7.89
Biophytum indicum	887.72	58.73	23.67	67.65
Boeraria hispida	110.12	107.87	16.00	109.51
Talinum triangulare	437.84	24.87	26.00	65.00
Portulaca oleraceae	292.56	55.80	17.47	75.07
Perennials				
Cynodon dactylon	494.93	105.10	43.87	96.50
Hiptis suaveolens	805.40	51.80	23.73	48.89
Commelina benghalensis	538.46	50.97	35.00	43.07
Chromolena odorata	379.97	27.80	17.40	35.52
Aerva lanata	442.40	58.13	9.47	46.09
Sida acuta	272.52	38.93	15.37	39.05
Selaginella pallascens	310.95	179.87	43.67	77.89
Tridax procumbens	310.23	60.40	21.43	182.43
Annuals (Mean)	475.48	52.00	21.36	64.71 NS
Perennials (Mean)	444.36	71.63	26.24	71.18 NS
CD (P=0.05)	1.05 *	12.30	3.0586	11.794

*logarithmic transformation; NS-Non significant

Nut quality characters are positively correlated with magnesium content. For optimum crop growth and yield in coconut, proper supply of magnesium is required among the other nutrients (Ohler, 1999). In this connection, it will be highly significant to find plant species which can accumulate significant amounts of Mg in their tissues. *Portulaca oleraceae*, a prostrate spreading annual weed recorded significantly higher Mg content of 319.67 mg kg^{-1} and uptake (0.80 mg plant^{-1}). The potential of *Portulaca oleraceae* in nutrient recycling process by way of composting was also emphasized by Angadi *et al*. (1977) and Biradar *et al*. (2006).

Sulphur is an important nutrient for overall growth of the palm as well as nut setting and oil quality characters (Taysum, 1981). Among the different species under study, significantly higher concentration (0.47%) and uptake (0.31g m^{-2}) was recorded by *S. pallascens*.

Micronutrients

Micronutrients such as iron, manganese, copper and zinc, because of their vital roles in bio-chemical and metabolic activities, have a direct bearing on coconut nutrition. Considering the phytoconcentration of iron in the species under study, statistical analysis revealed the highest concentration (887.73 mg kg^{-1}) and uptake (16.65 mg plant^{-1}) by *Biophytum indicum*.

Significant difference was observed among the weed species with regard to Mn content in tissues. The highest concentration of 179.9 mg kg^{-1} and

Table 4. Macro nutrient uptake by weed species in coconut garden (gm^{-2})

Name of weed	Primary nutrients				Secondary nutrients		
	N	P	K	Na	Ca (mg plant^{-1})	Mg (mg plant^{-1})	S
Annuals							
Solanum nigrum	0.30	0.03	0.48	0.006	0.08	0.032	0.04
Ageratum connyzoides	0.70	0.10	0.58	0 .013	0.21	0.093	0.06
Boerhavia diffusa	1.73	0.09	0.84	0 .005	0.21	0.118	0.14
Cleome viscosa	1.28	0.18	1.29	0.009	0.17	0.102	0.03
Amaranthus viridis	0.19	0.03	0.17	0 .003	0.08	0.144	0 .02
Phyllanthus niruri	1.70	0.09	0.46	0.035	0.27	0.546	0 .09
Amaranthus spinosus	0.46	0.06	0.10	0.012	0.06	0.152	0.04
Cleorodendrum infortunatum	0.51	0.03	0.09	0.003	0.33	0.121	0.02
Ipomoea pes- tigrdis	7.23	0.30	0.37	0.048	0.11	0.068	0.13
Biophytum indicum	0.57	0.07	0.27	0.005	0.36	0.178	0.04
Boeraria hispida	7.22	0.29	1.57	0.096	0.18	0.025	0.10
Talinum triangulare	0.70	0.06	0.33	0.009	0.10	0.106	0.04
Portulaca oleraceae	0.55	0.04	0.48	0.002	0.02	0.800	0 .02
Perennials							
Cynodon dactylon	1.09	0.18	1.29	0.234	0.26	0.105	0.06
Hiptis suaveolens	1.27	0.11	0.44	0.015	0.20	0.116	0.13
Commolena benghalensis	0.18	0.02	0.11	0.003	0.04	0.024	0.01
Chromolena odorata	0.30	0.02	0.10	0.003	0.10	0.020	0.03
Aerva lanata	1.26	0.17	1.81	0.027	0.18	0.103	0.10
Sida acuta	0.91	0.11	0.54	0.014	0.02	0 .006	0.06
Selaginella pallascens	1.48	0.42	2.96	0.074	0.22	0.302	0.31
Tridax procumbens	1.43	0.09	0.51	0.012	0.17	0.133	0.05
Annuals (Mean)	1.79	0.11	0.52	0 .019	0.17	0.136	0.06
Perennials (Mean)	0.99	0.14	0.97	0.048	0.150	0.101	0.095
CD (P=0.05)	3.06	0.010	0.394	0.014	0.0405	0.023	0.017

uptake (0.32 mg plant^{-1}) was recorded in *Selaginella pallascens.* Though there was significant difference within the group of annuals and perennials, there was no significant difference between the groups in their Cu concentration. The highest Cu content of 47.57 mg kg^{-1} was recorded by *Cleome viscosa* while *Cynodon dactylon* recorded the highest uptake (0.315 mg plant^{-1}) possibly due to its higher dry matter content.

Significantly higher Zn content (182.4 mg kg^{-1}) was recorded in *Tridax procumbens* followed by *Boeraria hispida* over other weed species. However, the uptake was higher (0.29 mg plant^{-1}) in *Cynodon dactylon.*

Weeds can act as key bearers in bio-geochemical cycling of nutrients. The highest value for nitrogen content among the annuals was recorded by *Ipomoea pes-tigridis* occupying a density of 5.7 m^{-2} which also recorded the highest value for uptake. As far as the content and uptake of P and K concerned, significantly superior value was recorded by *Selaginella pallescens* which had a density of 6.6 m^{-2}. In the case of Mg content, *Portulaca oleraceae* recorded the highest value. *Boeraria hispida*, an annual weed species which recorded a weed density of 10.9 m^{-2} showed the highest values for Mn and Zn uptake. Considering the nutrient content and weed density, the weed

Table 5. Micronutrient uptake by common weed species in coconut garden (mg plant^{-1})

Name of weed	Fe	Mn	Cu	Zn
Annuals				
Solanum nigrum	4.42	0.48	0.15	0.59
Ageratum conyzoides	11.84	0.71	0.40	0.94
Boerhavia diffusa	14.70	0.75	0.35	1.63
Cleome viscosa	6.31	0.67	0.59	0.51
Amaranthus viridis	4.86	1.01	0.21	0.79
Phyllanthus niruri	7.14	0.62	0.35	1.71
Amaranthus spinosus	6.15	0.30	0.16	0.65
Cleorodendrum infortunatum	9.88	1.89	0.64	1.31
Ipomoea pes-tigridis	1.67	0.20	0.14	0.12
Biophytum indicum	16.65	1.10	0.44	1.27
Boeraria hispida	1.15	1.13	0.17	1.14
Talinum triangulare	2.63	0.15	0.16	0.39
Portulaca oleraceae	0.73	0.14	0.04	0.19
Perennials				
Cynodon dactylon	14.85	1.80	1.32	2.89
Hiptis suaveolens	13.72	0.88	0.40	0.83
Commelina benghalensis	1.52	0.14	0.09	0.12
Chromolena odorata	3.25	0.24	0.15	0.30
Aerva lanata	10.79	1.42	0.23	1.13
Sida acuta	0.69	0.10	0.04	0.10
Selaginella pallascens	3.11	3.15	0.45	0.78
Tridax procumbens	3.28	0.64	0.23	1.93
Annuals (Mean)	6.78	0.70	0.30	0.87
Perennials (Mean)	6.40	1.05	0.36	1.01
CD (P=0.05)	0.184	0.200	0.04	0.21

species that can be utilized for nutrient recycling through composting are *Ipomoea pes-tigridis* (N), *Portulaca oleraceae* (N, P, Mg), *Selaginella pallescens* (P, K, Ca, Mg, S, Mn, Cu) and *Boeraria hispida* (Mn, Zn). Studies conducted on the weed floristic composition of palms gardens of eastern Himalayan regions by Sit *et al*. (2007) also showed the predominance of dicot weed species compared to that of monocots with a weed flora diversity of 0.618 in terms of Shannon index.

The present study in terms of nutrient composition as well as biomass uptake reveals the definite role of the particular weed species in recycling the nutrients and there by strengthening the biogeochemical nutrient cycling.

Acknowledgements

Authors are thankful to Dr. Vijayaraghava Kumar, Professor and Head, Agricultural Statistics, College of Agriculture, Vellayani for statistical analysis of the data.

References

Angadi, V.V., Chittapur, B.M., Basavaraj, B. and Mohankumar, H.D. 1977. Green manuring value of weeds in transplanted rice. In: *Proceedings of the First International Conference on Parthenium Management,* UAS, Dharwad, pp. 127.

Biradar, D.P., Shivakumar, K.S., Prakash, S.S. and Pujar, T. 2006. Bio-nutrient potentiality of *Parthenium hysterophorus* and its utility as green manure in rice ecosystem. *Karnataka Journal of Agricultural Science* **19**: 256-263.

Derksen, A.D., Anderson, L.R., Blackshaw, E.R. and Maxwell, B. 2002. Weed dynamics and management strategies in the Northern Great Plains. *Agronomy Journal* **3**: 174-185.

Harrington, K.C., Thatcher, A. and Kemp, P.D. 2006. Mineral composition and nutritive value of some common pasture weed. *New Zealand Plant Protection* **59**: 261-265.

Jackson, M.L. 1973. *Soil Chemical Analysis,* Prentice Hall of India Pvt. Ltd., New Delhi. 498 p.

Nair, R.G. and Chami, P. 1963. A survey of weeds in the fields of coconut research station, Kasargodu. *Indian Coconut Journal* **17**: 40-47.

Nelliat, E.V. 1973. N P K nutrition of coconut palm – A review. *Journal of Plantation Crops* **1**(suppl.): 70-80.

Ohler, J.G. 1999. Climate and soils. In: *Modern Coconut Management: Palm Cultivation and Products.* The Food and Agriculture Organization of the United Nations (FAO). Intermediate Technology Publications, London, pp. 35-53.

Prema, D., Jose, A.I. and Nambiar, P.K.N. 1987. Effect of sodium chloride on growth and yield of coconut palms in a laterite soil. *Agricultural Research Journal of Kerala* **25**(1): 66-73.

Promsakha, N.S.S., Cadisch, G., Toomsan, B., Vityakon, P., Limpinuntana, V., Jogloy, S. and Patanothai, A. 2006. Weeds-friend or foe? The role of weed composition on stover nutrient recycling efficiency. *Field Crops Research* **97**: 238-247.

Sit, A.K., Bhattacharya, M., Sarkar, B. and Arunachalam, V. 2007. Weed floristic composition in palm gardens in Plains of Eastern Himalayan region of West Bengal. *Current Science* **92**(10): 1434-1439.

Sudharmaidevi, C.R., Sunu, S., Neenu, S. and Vineetha, V. 2005. Effect of partial substitution of K by Na on the growth and yield of some tropical crops. In: Proceedings of the Plant Nutrition for Food Security, Human Health and Environmental Protection. Tsinghua University Press, Beijing, China. pp. 972-973.

Taysum, D.H. 1981. A report on a tour of coconut plantations in Southern Nampula and Zambezia Provinces (Mozambique). Internal Report, UNDP/FAO Project: MOZ/75/009 Rome (Italy).