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RESEARCH ARTICLE

ANALYSIS OF BOTANICALS USED IN AGRICULTURE PEST MANAGEMENT IN WAYANAD, SOUTH INDIA

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ABSTRACT

In this study, the main objective was to document all pesticide plants used in Wayanad district, a questionnaire based interview conducted among 200 rural farmers. All the data were recorded in previously designed data sheets to reflect different objectives. Sixty eight species belonging to 33 families were recorded during the survey. For analysis, Informant consensus factor (ICF) was calculated to indicate information homogeneity. The ICF value 1.00 is observed for *Azadirachta indica* and is considered as the most important pesticide species from the study area. Other important pesticide plant species are *Allium sativum* (0.97), *Nicotiana tabacum* (0.94), *Zingiber officinale* (0.71), *Pongamia pinnata* (0.64) and *Curcuma longa* (0.64). The minimum ICF value 0.04 is recorded for *Anamirta cocculus* followed by *Euphorbia hirta* (0.045), *Lobelia nicotonifolia* (0.045) and *Derris brevipes* (0.05) indicates the limited usage of this plant as bio-pesticide. Some important pesticide plants like *Derris brevipes*, *Madhuca longifolia*, *Quassia indica*, *Toddalia asiatica* were reportedly becoming increasingly rare and would need conservation efforts. Research on active components, pesticide preparations, application rates and environmental impact of botanical pesticides are a prerequisite for sustainable agriculture and recording this knowledge before it disappears with the aging farmers was seen as urgent.

INTRODUCTION

Subsistence farming is predominant in the rural areas of Wayanad districts of Kerala. Rice is the major food crop of this region. Ten tribal communities inhabit in different parts of the district with age long traditions and customs; about 80 % people reside in villages and in remote areas. Living in close proximity to the plants, the people use a large number of plants for food, medicine and material culture. They have knowledge about the properties of plants or plant products and use them accordingly. It is observed that 50-70 % of the total population directly depends upon agriculture based livelihood security. *Kurichya, Kuruma, Adiya* and *Paniya* are the major tribal communities engaged in agricultural activities and they use some plants or plant products for the control of pests in crops and the storage of their grains, cereals and pulses. It is estimated that field and storage pests destroy approximately 43% of potential production in developing Asian and African countries Ogendo *et al*. (2004). Furthermore, these smallholder farmers have been bypassed by agricultural modernization as new technologies were not made available to them on favorable terms, while some of which often do not suit their agro-ecological and socio-economic conditions. Pest management innovations are no exception. For instance, the promotion of synthetic pesticides in the control of insect pests though effective, is expensive and has raised health and environmental concerns Isman, (2008). The risks associated with use of synthetic insecticides are even higher among small scale farmers because of poverty and lack of skills to obtain and handle pesticides appropriately Saxena *et al*. (1990). Thus, pests particularly insects, continue to ravage crops and without proper protection systems, farmers continue to lose a great part of their produce. In recent years there has been an attempt to replace the synthetic insecticides with less expensive, locally available, ecologically safe and socio-friendly options including botanicals Talukder (2006). However, tribal farming communities' perceptions of pest problems and indigenous control methods employed are yet to be critically evaluated. The available information is mostly observational/ anecdotal and does not provide quantitative details about various socio-economic factors that influence the indigenous pest control practices Altieri (1993). As a result, the development and extension of improved and adaptable pest management technology for small scale farmers in developing countries is being re-examined. Hence, a study was conducted to document farmers' traditional knowledge and the factors that influence the use of botanicals as alternatives to synthetic insecticides in pest management in the agriculture systems of Wayanad, Kerala. Determination of this information will contribute

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towards for more research on improving use of botanical pesticides.

MATERIALS AND METHODS

Traditional knowledge and approaches on agricultural pest management were collected during 2010-2013 from different parts of Wayanad districts of Kerala by personal contact with knowledgeable informants including leading farmers, aged persons, and traditional practitioners. Critical observations were also made on the traditional knowledge followed by farmers for the management of diseases and pests of their crops. Total 200 farmers, selected using simple random sampling technique, were interviewed with the help of pre-designed questionnaires. Questionnaires related to the indigenous knowledge based practices for the management of pest and diseases that includes mostly the cultural practices followed by application of agricultural wastes and use of certain locally available medicinal plants. The medicinal plants used were collected by visiting the actual field sites. Some of the explored Indigenous Traditional Knowledge (ITKs) of the rural farming communities of Wayanad for the management of agricultural pests and diseases are documented. Voucher specimens were collected along with their vernacular names. Parts used and mode of administration were also recorded in detail. The specimens were identified by the authors with the help of authentic herbarium sheets preserved in the herbarium of M. S. Swaminathan Research Foundation, Wayanad. All the data were recorded in previously designed data sheets to reflect different objectives. For analysis, species recorded were assessed for User Value (UV) Heinrich *et al.* (1998); Aburjai *et al*. (2007) - a quantitative method that demonstrates the relative importance of species locally UV = $\sum$ U/n, where UV is the user value, *U* is the number of user citations and *n* is the number of respondents. Informant consensus factor (ICF) was calculated to indicate information homogeneity. According to the latter authors, ICF will be lower (closer to 0), if there is a large variation in plant use or when users do not exchange information about plant uses. High values (close to 1) reflect well defined plant use or information exchange between respondents. UV and ICF values are reflected in Table 1.

RESULTS AND DISCUSSION

Sixty eight species belonging to 33 families were recorded during the survey (Table 1). The maximum ICF value 1.00 is observed for *Azadirachta indica* and is considered as the most important pesticide species from the study area. Other important pesticide plant species are *Allium sativum* (0.97), *Nicotiana tabacum* (0.94), *Zingiber officinale* (0.71), *Pongamia pinnata* (0.64) and *Curcuma longa* (0.64).

The minimum ICF value 0.04 is recorded for *Anamirta cocculus* followed by *Euphorbia hirta* (0.045), *Lobelia nicotonifolia* (0.045) and *Derris brevipes* (0.05) indicates the limited usage of this plant as bio-pesticide. The most used families were Fabaceae with 8 species, Lamiaceae (7), Asteraceae (5) and Zingiberaceae (4). Out of 33 families, five families namely Araceae, Liliaceae, Zingiberaceae, Poaceae and Arecaceae belong to monocotyledonous subdivision while the rest are dicotyledonous. Leaves were named as plant parts most-used in formulation of pesticides. They were reported for 51 species out of the total 68 cited in the survey. They were followed by root/rhizomes/bulb and the fruits/seeds with 8 and 7 species, respectively. Flowers of 3 plants, bark of 1 species is also being used as pesticide and young branch of *Toddalia asiatica* and *Zizhiphus oenoplia* are used as physical trap against rodents and birds in agriculture fields (Fig. 1). Water extract was the most common mode of formulation accounting for 49 formulations. Others included use of the whole plant as an intercrop, that is, trap/ crop repellant (3), use of crushed seed cake (2), application of plant oil extract (7), latex spray (5), ash admixture (5), use of thorns as deterrents (5) and use of powder from plant parts (6). Numerous pests were mentioned during the survey but it was apparent that farmers were neither familiar with formal classification nor names of pests and diseases. Most farmers gave broad answers such as weevils, storage pests, caterpillars, insects, moths or field pests. It was therefore difficult to obtain meaningful data for comparison. During interviews respondents also pointed out the difficulty of naming particular pests affecting certain plants as the extracts are used for controlling the pests when there is infestation in the field without establishing the identity of the causative pests. After all, many plants are used in combination with others. Therefore, plants were reported to be used against a range of pests. All groups include the corresponding diseases. Table 2 shows the most cited pesticide with mode of formulation and pests they control. However, all groups showed a high ICF (1.00) indicative of the fact that there is a high user consensus among the farmers and a likelihood of sharing ideas about use of botanicals. This study shows that numerous plant species are used in the region for the purpose of pest management. Notable ones such as *Azadirachta indica*, *Allium sativum*, *Nicotiana tabacum*, *Pongamia pinnata* dominate the application scene but a few 'new ones' like *Anamirta cocculus*, *Lobelia nicotinifolia* and *Derris brevipes* were also documented for the first time in this region. Therefore, there is need to establish their efficacy and identify the pests against which their extracts are most active; also, the need for conservation of such species whose pesticide and repellant properties were noted. The earlier it is done, the better it will be for pest management and biodiversity.

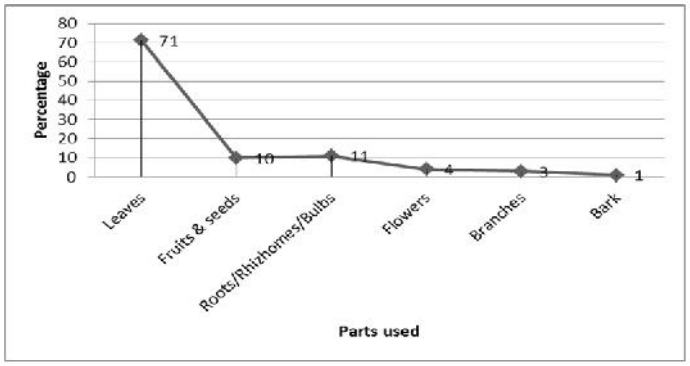

Fig. 1. Percentage of plant parts used as pesticides

Table 1. List of species, their families, plant parts used and Use Values (UVs)

S.No.	Scientific Name	Local Name	Family	Part (s) Used	Times mentioned	Use value
1.	*Abrus precatorius* L.	Kunnikuru	Fabaceae	L, S	73	0.36
2.	*Acacia nilotica* (L.) Willd. ex Del.	Karingali	Mimosaceae	L, Bk	34	0.17
3.	*Acalypha indica* L.	Kuppameni	Euphorbiaceae	L	21	0.10
4.	*Acorus calamus* L.	Vayambu	Araceae	Rh	47	0.23
5.	*Ageratum conyzoides* L.	Appa	Asteraceae	L	49	0.24
6.	*Allium sativum* L.	Vellulli	Liliaceae	B	194	0.97
7.	*Alpinia calcarata* Rosc.	Chittaratha	Zingiberaceae	Rh	56	0.28
8.	*Anamirta cocculus* (L.) Wight & Arn.	Najuvalli	Menispermaceae	F	8	0.04
9.	*Andrographis neesiana* Wight	Kattukiriyatha	Acanthaceae	L	39	0.19
10.	*Andrographis paniculata* (Burm. f.) Wall.exNees	Kiriyatha	Acanthaceae	L	56	0.28
11.	*Annona reticulata* L.	Aatta	Anonaceae	L	48	0.24
12.	*Artemisia nilagarica* (Clarke) Pamp.	Kattukarpooram	Ateraceae	L	18	0.09
13.	*Azadirachta indica* A.Juss.	Veppu	Meliaceae	L, S	200	1.00
14.	*Brassica nigra* (L.) Koch.	Kaduku	Brassicaceae	S	56	0.28
15.	*Calotropis gigantea* (L.) R. Br.	Arukku	Asclepiadaceae	L	43	0.21
16.	*Camellia sinensis* (L.) O.Ktze.	Theyila	Theaceae	L	36	0.18
17.	*Capsicum frutescens* L.	Mulaku	Solanaceae	F	86	0.43
18.	*Caryota urens* L.	Choondapana	Arecaceae	F	31	0.15
19.	*Cassia fistula* L.	Kanikonna	Fabaceae	L	19	0.09
20.	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.f.	Odaku	Phyllanthaceae	L	15	0.07
21.	*Clerodendrum infortunatum* L.	Peru	Verbenaceae	L	76	0.38
22.	*Croton tiglium* L.	Nanju	Euphorbiaceae	S	22	0.11
23.	*Curcuma longa* L.	Manjal	Zingiberaceae	Rh	128	0.64
24.	*Cymbopogon citratus* (DC.) Stapf	Pulthailam	Poaceae	L	33	0.16
25.	*Datura metel* L.	Ummam	Solanaceae	L, S	82	0.41
26.	*Derris brevipes* (Benth.) Baker	Pannikodi	Fabaceae	R	11	0.05
27.	*Derris scandens* (Roxb.) Benth.	Pannivalli	Fabaceae	L,R	16	0.08
28.	*Eucalyptus globulus* Labill.	Eucaly	Myrtaceae	L	18	0.09
29.	*Euphorbia hirta* L.	Nilapala	Euphorbiaceae	L	9	0.04
30.	*Ficus hispida* L. f.	Parakam	Moraceae	L	29	0.14
31.	*Gliricidia sepium* (Jacq.) Kunth ex Walp.	Seemakonna	Fabaceae	L	33	0.16
32.	*Glycosmis pentaphylla* (Retz.) DC.	Panal	Rutaceae	L	63	0.31
33.	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don	Aval	Euphorbiaceae	L	15	0.07
34.	*Hydnocarpus pentandra* (Buch.-Ham.) Oken	Marotti	Flacourtiaceae	S	49	0.24
35.	*Hyptis suaveolens* (L.) Poit.	Nattapoochedy	Lamiaceae	L	14	0.07
36.	*Jatropha curcas* L.	Kadalavanakku	Euphorbiaceae	L	91	0.45
37.	*Jatropha multifida* L.	Kattavanakku	Euphorbiaceae	L	23	0.11
38.	*Justicia adhatoda* L.	Adalodakam	Acanthaceae	L	32	0.16
39.	*Kaempferia rotunda* L.	Kacholum	Zingiberaceae	Rh	65	0.32
40.	*Lantana camara* L.	Kongini	Verbenaceae	L	46	0.23
41.	*Leucas aspera* (Willd.) Link	Thumba	Lamiaceae	L	29	0.14
42.	*Lobelia nicotianifolia* Roth ex Roem. & Schult.	Kattupukayila	Lobeliaceae	L	9	0.04
43.	*Madhuca longifolia* (Koenig) J.F. Macbr.	Ilippa	Sapotaceae	L	13	0.06
44.	*Manihot esculenta* Crantz.	Kappa	Euphorbiaceae	L	16	0.08
45.	*Moringa oleifera* Bedd.	Muringa	Moringaceae	L, S	84	0.42
46.	*Nicotiana tabacum* L.	Pokala	Solanaceae	L	188	0.94
47.	*Ocimum americanum* L.	Kattuthulasi	Lamiaceae	L	12	0.06
48.	*Ocimum gratissimum* L.	Ramathulasi	Lamiaceae	L	18	0.09
49.	*Ocimum tenuiiflorum* L.	Thulasi	Lamiaceae	L	109	0.54
50.	*Plectranthus amboinicus* (Lour.) Spreng.	Panikoorka	Lamiaceae	L	61	0.30
51.	*Plectranthus hadiensis* (Forssk.) Schweinf.	Iruveli	Lamiaceae	L	33	0.16
52.	*Plumbago zeylanica* L.	Vellakoduveli	Plumbaginaceae	R	49	0.24
53.	*Pongamia pinnata* (L.) Pierre	Ungu	Fabaceae	L, S	128	0.64
54.	*Psidium guajava* L.	Pera	Myrtaceae	L	13	0.06
55.	*Quassia indica* (Gaertn.) Nooteb.	Karingotta	Icacinaceae	L	21	0.10
56.	*Ricinus communis* L.	Avanakku	Euphorbiaceae	S	52	0.26
57.	*Senna tora* (L.) Roxb.	Thakara	Fabaceae	L	28	0.14
58.	*Sterculia urens* Roxb.	Kavalam	Sterculiaceae	L	22	0.11
59.	*Tabernaemontana alternifolia* L.	Kurudipala	Apocynaceae	L	33	0.16
60.	*Tagetes erecta* L.	Chendumally	Asteraceae	L, Fl	46	0.23
61.	*Tanacetum parthenium* (L.) Sch.-Bip.	Jammanthy	Asteraceae	L,Fl	33	0.16
62.	*Tephrosia purpurea* (L.) Pers.	Kalakomban	Fabaceae	L	14	0.07
63.	*Tithonia diversifolia* (Hemsl.) A. Gray	Kattusooryakanthy	Asteraceae	L, Fl	34	0.17
64.	*Toddalia asiatica* (L.) Lam.	Kokkathodali	Rutaceae	Br	21	0.10
65.	*Vitex negundo* L.	Karinochi	Verbenaceae	L	125	0.62
66.	*Wrightia tinctoria* (Roxb.) R. Br.	Dhanthapala	Apocynaceae	L	19	0.09
67.	*Zingiber officinale* Rosc.	Inji	Zingiberaceae	Rh	143	0.71
68.	*Ziziphus oenoplia* (L.) Mill.	Thodali	Rhamnaceae	Br	16	0.08

R: Roots, Rh: Rhizomes, B: Bulbs, L: Leaves, Br: Branches, Bk: Barks, Fl: Flowers, F: Fruits, S: Seeds

Table 2. Record of pesticide with mode of formulation and pests they control

Sl No.	Scientific Name	Mode of formulation	Pest/disease treated
1.	*Abrus precatorius* L.	Water extract	Worms
2.	*Acacia nilotica* (L.) Willd. ex Del.	Powder	Mites, moles
3.	*Acalypha indica* L.	Water extract	Thrips, flies
4.	*Acorus calamus* L.	Water extract	Worms, flies
5.	*Ageratum conyzoides* L.	Water extract	Fungal infections
6.	*Allium sativum* L.	Trap crop, water extract	Field pests, storage pests, flies
7.	*Alpinia calcarata* Rosc.	Water extract	Storage pests
8.	*Anamirta cocculus* (L.) Wight & Arn.	Crashed seeds	Snails, moths
9.	*Andrographis neesiana* Wight	Water extract	Fungal infections
10.	*Andrographis paniculata* (Burm. f.) Wall. ex Nees	Water extract	Fungal infections
11.	*Annona reticulata* L.	Water extract	Insects, Fungal infections
12.	*Artemisia nilagarica* (Clarke) Pamp.	Water extract, Trap crop	Insects
13.	*Azadirachta indica* A.Juss.	Water extract, crashed seed cake, oil extract	Insects, worms
14.	*Brassica nigra* (L.) Koch.	Oil extract	Worms
15.	*Calotropis gigantea* (L.) R. Br.	Latex spray, water extract	Aphids, Safari ants
16.	*Camellia sinensis* (L.) O.Ktze.	Water extract	Stem borer, cut worms
17.	*Capsicum frutescens* L.	Crashed seeds, water extract	Cut worms, ants
18.	*Caryota urens* L.	Ash dusting	Soil pests
19.	*Cassia fistula* L.	Water extract	Thrips, storage pests
20.	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.f.	Physical trap, Water extract	Insects
21.	*Clerodendrum infortunatum* L.	Powder	Cut worms
22.	*Croton tiglium* L.	Water extract	Insects, Moths, Ants
23.	*Curcuma longa* L.	Powder	Ants, fungicidal properties
24.	*Cymbopogon citratus* (DC.) Stapf	Oil extract	Cut worms
25.	*Datura metel* L.	Water extract	Aphids
26.	*Derris brevipes* (Benth.) Baker	Water extract	Rats
27.	*Derris scandens* (Roxb.) Benth.	Water extract	Rats
28.	*Eucalyptus globulus* Labill.	Oil extract	Cut worms, insects
29.	*Euphorbia hirta* L.	Water extract	Insect pests, worms
30.	*Ficus hispida* L. f.	Physical trap	Flies
31.	*Gliricidia sepium* (Jacq.) Kunth ex Walp.	Water extract, smoke	Field pests, storage pests, flies
32.	*Glycosmis pentaphylla* (Retz.) DC.	Water extract	Storage pests
33.	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don	Water extract	Aphids
34.	*Hydnocarpus pentandra* (Buch.-Ham.) Oken	Oil extract	Aphids
35.	*Hyptis suaveolens* (L.) Poit.	Water extract	Pod feeder
36.	*Jatropha curcas* L.	Sap spray, Oil extract	Worms
37.	*Jatropha multifida* L.	Sap spray	Stem borer, cut worms
38.	*Justicia adhatoda* L.	Water extract	Fungal infections
39.	*Kaempferia rotunda* L.	Powder	Storage pests
40.	*Lantana camara* L.	Water extract	Insects
41.	*Leucas aspera* (Willd.) Link	Water extract	Storage pests
42.	*Lobelia nicotianifolia* Roth ex Roem. & Schult.	Water extract	Fungal infections
43.	*Madhuca longifolia* (Koenig) J.F. Macbr.	Water extract	Mites, moles
44.	*Manihot esculenta* Crantz.	Water extract	Aphids
45.	*Moringa oleifera* Bedd.	Powder, water extract	Most insects
46.	*Nicotiana tabacum* L.	Water extract, smoke	Field pests, storage pests
47.	*Ocimum americanum* L.	Water extract	Insects
48.	*Ocimum gratissimum* L.	Water extract	Storage pests
49.	*Ocimum tenuiiflorum* L.	Water extract	Insects, ticks
50.	*Plectranthus amboinicus* (Lour.) Spreng.	Water extract	Fungal infections
51.	*Plectranthus hadiensis* (Forssk.) Schweinf.	Water extract	Fungal infections
52.	*Plumbago zeylanica* L.	Physical trap	Rodents
53.	*Pongamia pinnata* (L.) Pierre	Oil extract	Aphids
54.	*Psidium guajava* L.	Water extract	Fungal infections
55.	*Quassia indica* (Gaertn.) Nooteb.	Water extract	Termites, army worm
56.	*Ricinus communis* L.	Oil extract	Stem borer, cut worms
57.	*Senna tora* (L.) Roxb.	Water extract	Weevils
58.	*Sterculia urens* Roxb.	Water extract, Ash dusting	Ticks
59.	*Tabernaemontana alternifolia* L.	Latex spray, water extract	Birds
60.	*Tagetes erecta* L.	Water extract	Nematodes, soil pests
61.	*Tanacetum parthenium* (L.) Sch.-Bip.	Water extract	Worms
62.	*Tephrosia purpurea* (L.) Pers.	Water extract	Nematodes, soil pests
63.	*Tithonia diversifolia* (Hemsl.) A. Gray	Water extract, Trap crop	Ants, Insects
64.	*Toddalia asiatica* (L.) Lam.	Physical trap	Rodents
65.	*Vitex negundo* L.	Water extract	Storage pests, Fungal infections
66.	*Wrightia tinctoria* (Roxb.) R. Br.	Latex spray, water extract	Birds
67.	*Zingiber officinale* Rosc.	Powder	Fungal infections
68.	*Ziziphus oenoplia* (L.) Mill.	Physical trap	Rodents

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