

# Phyto-sociological survey of weeds in direct seeded rice (*Oryza sativa* L.)

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## ABSTRACT

Field observation was carried out at Melbhuvanagiri block, (Valayamadevi, Periyankunam, Agara Alambadi and Periyakuppam villages), Cuddalore district during 2020 to determine the phytosociological characters of weeds in direct seeded rice fields. The composition of the weed species in the fields was evaluated by randomly throwing 0.25 m<sup>2</sup> quadrat in 10 different locations in each village. Frequency, density, abundance and their relative values were calculated. Highest relative frequency, relative density, relative abundance and importance value index was observed with *Echinochloa colona* (L.) Link among grasses, *Cyperus difformis* L. among sedges and *Eclipta alba* (L.) Hassk among broad leaved weeds in all the observed villages of direct seeded rice fields. Diversity indices were worked out for each village, among them Periyankunam village recorded the highest diversity indices (Shannon index (H') of 2.234, Simpson index (D) of 0.873 and Evenness index (E) of 2.070) in direct seeded rice. Hence weeds were prominent in Periyankunam village than all the observation sites.

**Key words:** Rice, Phytosociology, Diversity indices, Importance value index

## Introduction

Rice (*Oryza sativa* L.) is one of the most important staple food crop for more than half of the world's population and provides about 21 per cent of the total calorie intake of the world population. The world's total area under rice is 161.1 million hectare and production is about 480.3 million tones along with the productivity of 2.98 t ha<sup>-1</sup>. Rice is the fore most important crop in India where it is grown in an area of 44.1 million hectare with an annual production of 106.7 million tones and average productivity is 2.4 t ha<sup>-1</sup> (Shipra Yadav *et al.*, 2020). In recent years, rice production has increased with the introduction of high yielding varieties, but their maximum yield potential has not been fully realized

owing to improper weed management. Weeds are the main obstacles to rice production due to their ability to compete with CO<sub>2</sub>, space, moisture, sun light and nutrients. Weeds are most severe and widespread biological constraints to crop production in India and alone cause 33 per cent of losses out of total losses due to pests (Verma *et al.*, 2015). The extent of damage depends upon the nature of weeds, their density, dominance, ecological success and the association with the crops and other biotic and edaphic factors (Sinha, 2017). Therefore, understanding the association between weed species in arable fields would support the development of sustainable weed control techniques including optimized herbicide recommendation. This may be achieved by carrying out weed survey and studies

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on phytosociology which may contribute with knowledge on weed community structure. Phytosociological indices and parameters, such as the importance value index (IVI), offer a view of the composition and the distribution of plant species in a community through ecological evaluation methods (Concenco *et al.*, 2013). Considering the above facts field observation was carried out to determine the phytosociological characters of weeds in direct seeded rice fields.

## Materials and Methods

The observation was conducted at four selected villages *viz.*, Valayamadevi, Periyankunam, Agara Alambadi and Periyakuppam of Melbhuvanagiri block, Cuddalore district during 2020. Soil in the observation sites was low in available Nitrogen, medium in available Phosphorous and high in available Potassium. Weed species compositions in the fields were assessed by throwing 0.25 m<sup>2</sup> quadrates randomly in 10 different locations in each village. The structure and composition of vegetation in the agricultural fields have been compared in terms of frequency, density, abundance and their relative values were derived from the primary data (Curtis, 1959).

### Formulae for calculating various phytosociological attributes studied are as follows

- i. Frequency (F) = Number of quadrates in which the species occurs / Number of quadrates studied
- ii. Density (D) = Total number of individuals of a species in all the quadrates / Number of quadrates studied
- iii. Abundance (A) = Total number of individuals of a species / Number of quadrates in which the species occurs
- iv. Relative Frequency (RF) = (Frequency value for a species / Total of Frequency value for all the species) × 100
- v. Relative Density (RD) = (Density value for a species / Total of Density value for all the species) × 100
- vi. Relative abundance (RA) = (Abundance value for a species / Total of abundance value for all the species) × 100

### Importance Value Index (IVI) (Phillips, 1959)

Important Value Index is valuable statistical measures for the analysis of phytosociology and plant

community and it provides an overall idea of a species and its importance in the plant community. It is derived by summing up Relative Frequency, Relative Density and Relative Abundance.

$$\text{Importance Value Index (IVI)} = \text{RA} + \text{RD} + \text{RF}$$

### Species Diversity Index (Shannon-Wiener, 1963)

Shannon-Wiener Index (1963) is one of the widely used indices for measuring species diversity. Shannon-Wiener index (H) =  $- \sum [P_i (\ln P_i)]$

Here  $P_i$  = (Number of individual of one weed species / Total number of all individual of weed species) × 100

### Simpson index (D)

$$D = 1 / \sum P_i^2$$

where  $P_i$  = proportion of individuals of species "i" divided by the total number of individuals in the sample, and D = diversity of Simpson.

### Evenness index (Pielou, 1977)

$$\text{Evenness index (E)} = H / H_{\text{max.}} \text{ or } = H / \log S$$

Here H = Shannon Wiener diversity index and S = Total number of species.

## Results and Discussion

### Weed species composition

Fourteen weed species belonging to nine families were found in all the different observation site of direct seeded rice fields. Among the 14 weed species the number of weed species belonging to monocot were 9 (64.28 per cent), dicot were 4 (28.58 per cent) and 1 Pteridophyte (7.14 per cent). Regarding lifecycle 8 were annual, 3 were perennial and 3 were annual/ perennial. Among several categories of weeds grasses were predominant in all four sites in both the method of rice fields next to sedges and broad leaved weeds (Table 1).

### Frequency, Density and Abundance

#### Direct seeded rice fields

The Frequency, density and abundance of various weed species in direct seeded rice fields were presented in Table 2. Among the different grassy weeds, *Echinochloa colona* (L.) Link recorded highest frequency of weed population in all the four villages. The highest frequency of sedge weed population in Valayamadevi (0.9) and Periyankunam (0.8) was observed in *Cyperus difformis* L. while

**Table 1.** Composition of weed flora in direct seeded rice field

S. No	Scientific name	Common name	Family	Group	Life cycle
1	<i>Bergia capensis</i> L.	White water fire	Elatinaceae	Dicot	Annual
2	<i>Commelina benghalensis</i> L.	Dayflower	Commelinaceae	Monocot	Annual
3	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda grass	Poaceae	Monocot	Perennial
4	<i>Cyperus difformis</i> L.	Umbrella sedge	Cyperaceae	Monocot	Annual
5	<i>Cyperus rotundus</i> (L.)	Purple nut sedge	Cyperaceae	Monocot	Perennial
6	<i>Digera arvensis</i> Forsk.	False amaranth	Amaranthaceae	Dicot	Annual
7	<i>Echinochloa colona</i> (L.) Link	Jungle rice	Poaceae	Monocot	Annual
8	<i>Echinochloa crusgalli</i> (L.)	Barnyard grass	Poaceae	Monocot	Annual
9	<i>Eclipta alba</i> (L.) Hassk.	False daisy	Asteraceae	Dicot	Annual
10	<i>Fimbristylis miliacea</i> (L.) Vahl	Hoorah grass	Cyperaceae	Monocot	Annual or Perennial
11	<i>Leptochloa chinensis</i> (L.) Nees	Red sprangletop	Poaceae	Monocot	Annual or Perennial
12	<i>Marsilea quadrifolia</i> L.	Four leaf clover	Marsileaceae	Pteridophyte	Perennial
13	<i>Monochoria vaginalis</i>	Pickerel weed	Pontederiaceae	Monocot	Annual or Perennial
14	<i>Phyllanthus niruri</i> L.	Seed under leaf	Phyllanthaceae	Dicot	Annual

F- Frequency, D- Density and A- Abundance

Agara Alambadi and Periyakuppam was observed in *Cyperus rotundus* (L.) (0.8). Regarding broad leaved weeds, *Bergia capensis* L. and *Eclipta alba* (L.) Hassk has highest frequency in all the observation sites. In Valayamadevi the minimum frequency value (0.3) was recorded in *Phyllanthus niruri* L but this weed species was not present in remaining 3 villages.

Weed species *Echinochloa colona* (L.) Link showed highest density in all the observation sites viz., Valayamadevi (12.6), Periyankunam (12.9), Agara Alambadi (9.6) and Periyakuppam (9.2) which was followed by *Cyperus difformis* L. viz., Valayamadevi

(11.2), Periyankunam (10.6), Agara Alambadi (8.0) and Periyakuppam (7.8). In Valayamadevi the minimum density value (0.4) was recorded in *Phyllanthus niruri* L but this weed species was not present in remaining 3 villages.

Weed abundance value (dominance) of Valayamadevi ranges from (1.33 to 12.60), Periyankunam (3.00 to 14.33), Agara Alambadi (1.60 to 11.40) and Periyakuppam (1.20 to 11.10). *Cyperus difformis* L. have the highest dominance value in Agara Alambadi (11.40) and Periyakuppam (11.10) while *Echinochloa colona* (L.) Link has the highest abundance value in Valayamadevi (12.60),

**Table 2.** The frequency, density and abundance of different weed species in direct seeded rice crop at the observation sites

S.No	Scientific name	Valayamadevi			Periyankunam			Agara Alambadi			Periyakuppam		
		F	D	A	F	D	A	F	D	A	F	D	A
1	<i>Bergiacapensis</i> L.	0.7	4.3	6.14	0.6	4.4	7.33	0.8	4.0	5.00	0.7	3.8	5.40
2	<i>Commelinabenghalensis</i> L.	0.5	1.4	2.80	0.4	1.9	4.75	0.4	0.9	2.20	0.5	0.8	1.60
3	<i>Cynodondactylon</i> (L.) Pers	0.6	3.8	6.33	0.6	3.7	6.16	0.5	2.8	5.60	0.6	2.6	4.30
4	<i>Cyperusdifformis</i> L.	0.9	11.2	12.44	0.8	10.6	13.25	0.7	8.0	11.40	0.7	7.8	11.10
5	<i>Cyperusrotundus</i> (L.)	0.8	7.5	9.37	0.7	8.0	11.42	0.8	4.0	5.00	0.8	3.8	4.70
6	<i>Digera arvensis</i> Forsk	0.4	1.3	3.25	0.3	1.9	6.33	0.3	0.5	1.60	0.4	0.5	1.20
7	<i>Echinochloacolona</i> (L.) Link	1.0	12.6	12.60	0.9	12.9	14.33	1.0	9.6	9.60	1.0	9.2	9.20
8	<i>Echinochloacrugalli</i> (L.)	0.8	8.8	11.00	0.7	8.2	11.71	0.7	6.0	8.50	0.7	5.9	8.40
9	<i>Eclipta alba</i> (L.) Hassk	0.7	5.0	7.14	0.6	4.6	7.66	0.8	4.5	5.60	0.9	4.2	4.60
10	<i>Fimbristylismiliacea</i> (L.) Vahl	0.6	1.5	2.50	0.5	1.9	3.80	0.5	1.1	2.20	0.5	1.0	2.00
11	<i>Leptochloachinensis</i> (L.) Nees	0.2	0.7	3.50	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.00
12	<i>Marsileaquadrifolia</i> L.	0.5	1.5	3.00	0.5	1.5	3.00	0.4	1.0	2.50	0.4	0.9	2.20
13	<i>Monochoria vaginalis</i>	0.4	1.1	2.75	0.2	1.8	5.50	0.2	0.5	2.50	0.3	0.4	1.30
14	<i>Phyllanthus niruri</i> L.	0.3	0.4	1.33	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.00



**Table 4.** Diversity indices

Villages	Valayamadevi	Periyankunam	Agara Alambadi	Periyakuppam
Diversity indices				
Shannon index (H')	2.214	2.234	2.147	2.132
Simpson index (D)	0.873	0.873	0.861	0.859
Evenness index (E)	1.932	2.070	1.989	1.976

(47.49, 49.27, 52.00 and 52.24 in Valayamadevi, Periyankunam, Agara Alambadi and Periyakuppam respectively). The lowest IVI at Valayamadevi (5.80) was recorded in *Phyllanthus niruri* L but this weed species was not present in remaining 3 villages. The lowest IVI was recorded in *Digera arvensis* Forsk at Agara Alambadi (7.97), *Monochoria vaginalis* at Periyankunam (11.64) and Periyakuppam (7.29).

Observations described above indicates that *Echinochloa colona* (L.) Link and *Cyperus difformis* (L.) have been found to be most frequently distributed and are important weed species in direct seeded rice fields at all the four villages.

#### Diversity indices

Diversity indices for direct seeded rice was calculated and presented in Table 4. Shannon's H index of weed species diversity were higher in Periyankunam rice field (2.234) which is closely followed by Valayamadevi (2.214), the lowest H index was recorded in Periyakuppam (2.132). From this observation rice field in Periyankunam has the highest weed density and possessed a proportionally higher species diversity than other villages.

Simpson index of all the four villages are close to each other.

Likewise, the highest evenness index was observed in Periyankunam (2.070) followed by Agara Alambadi (1.989). The highest evenness index means weed species were uniformly distributed in it. Hence, weed species were uniformly distributed in Periyankunam. The lowest evenness index was observed in Valayamadevi (1.932) which indicates the species were clumped together within their habitat and therefore not evenly spaced. Similar findings were reported by Sinha, (2017).

#### Conclusion

Highest relative frequency, relative density, relative abundance and highest importance value index was

observed with *Echinochloa colona* (L.) Link, *Cyperus difformis* L. and *Eclipta alba* (L.) Hassk among grasses, sedges and broad leaved weeds respectively, in all the observed villages of direct seeded rice. Among the four villages compared, Periyankunam shows highest relative values, importance value index and diversity indices viz., Shannon-Wiener (H'), Simpson (D) and Evenness (E) indices than other villages. From the calculated diversity indices it can be concluded that Periyankunam has the highest weed diversity and weed species were uniformly distributed in it over other three villages.

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