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Biological Studies on Weed Seed Bank and Weed Flora in Kattumannarkoil Block of Cuddalore District

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ABSTRACT

Weeds are one of the most difficult hazards to agricultural fields, harming crop productivity and consequently imposing a substantial cost on agriculture. The current study was conducted in 2020 to detect weeds in soil seed banks and weed diversity in Kattumannarkoil block low-land rice fields. A total of 16 species were revealed: 4 sedges, 3 grasses and 9 broadleaf weeds. Among the weed species found, the problematic weeds detected in the study area include *Cyperus rotundus*, *Cyperus difformis* and *Echinochloa colonum*. The survey values indicated that highest Relative dominance, density, frequency and IVI was recorded by *Cyperus rotundus* followed by *Cyperus difformis* and *Echinochloa colonum*. The study of weed seed bank shows that highest density was recorded by sedges on both 30 and 45 days.

Keywords Sedges, Relative dominance, Relative density, Relative frequency, IVI.

INTRODUCTION

Rice is the major staple food crop of India. It plays a major role in the economics and social stability of the world. About 90% rice production and consumption worldwide occurs in Asia (Singh *et al*. 2009). As per the 2nd Advance estimates of Agriculture crops 2021-22, rice production accounts for 127.93 million tonnes in India (Anonymous 2022). The major obstructions for the production and yield losses in rice are disease and pest incidence in addition weeds combinedly affect the crop yield loss. Damage caused by weeds cannot be identified in early stage as compared to insect damage, so that weeds act as hidden war on crop plants (Murugan and Kathiresan 2010). In low land conditions weeds are the major concern for low productivity and higher income loss. Weeds have highest fecundity producing hundreds of thousands of seeds during single growing season, reproduce through vegetative propagules and seeds have vegetative mimicry with crops in addition to long time seed dormancy (Alhassan *et al*. 2015). Many weed species have almost identical growth and requirements as paddy. Due to limited cultivable land, low agricultural yield is exacerbated by numerous weeds and rice crops.

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Uncontrolled growth of weeds in paddy reduced the grain yield by 75.8, 70.6 and 62.6% in dry seeded rice, wet seeded rice and transplanted rice, respectively (Soni *et al*. 2022). It is necessary to evaluate the loss in rice crop production caused by these undesirable, ineffectual and persistent weed species. Limiting rice biomass loss and controlling the most frequent and prolific weed of impoverished farmers. Weed seed bank in the soil is a dynamic system with inputs and outputs. The inputs occur via seed rain as a result of efficient dispersion mechanisms and the outputs by means of germination, predation and decay or seed death (Mohler *et al*. 2012). Many researchers were conducted on quantification of weed species in soil seed bank from low land ecosystem. However, due to its economic importance the status of weed seed bank in low land system needed to be further investigation.

Dynamic, composition and competition by weeds is dependent on soil, climate, cropping and management factors (Dinesh *et al*. 2020). Rice suffers more by weed infestation. Apart from various customary methods of weed control crops suffer a lot by weeds, their density, dominance, ecological success and the association with the crops and other biotic and edaphic factors (Sinha *et al*. 2017). As a result, a thorough survey of weeds in crop fields is required, and these objectives can be met by gaining a deeper understanding of the biology of the many weeds that infest rice fields. Keeping the above facts on view the present study was focused on "Survey on weed diversity ad weed seed bank ecology in Rice fields of Kattumannarkoil block.

MATERIALS AND METHODS

The survey and weed seed bank study was conducted in Kattumannarkoil block of Tamil Nadu state. Fig. 1. shows the map of study area. It is situated between 11.28° N latitude and 79.55° E longitude. It lies under Veeranam command area. The survey was conducted in the selected rice fields where the weed management is not practiced. A quadrate of 1.0 x 1.0 m^2 is used for surveying with the help of "Handbook on Weed identification" (Naidu 2012) and Weed seed atlas (Naidu and Varshiney 2007). To determine the abundance various ecological characters like Relative dominance, Relative density, Relative frequency and Important Value Index (IVI) were calculated by using formula given by Curtis JT 1959.

$$\text{Relative dominance R.Do.(\%):} \frac{\text{Dominance of particular species}}{\text{Sum total of the dominance of all species}} \times 100$$

$$\text{Relative density R.De.(\%)} = \frac{\text{Dominance of particular species}}{\text{Sum total of the density of all species}} \times 100$$

$$\text{Relative frequency R.F (\%)} = \frac{\text{Frequency of particular species}}{\text{Sum total of the frequency of all species}} \times 100$$

$$\text{Importance value index (IVI)} = \text{R.Do+R.De+R .F}$$

Species diversity index (Shannon and Weiner 1963)

Shannon weiner index (H) = Pi log Pi

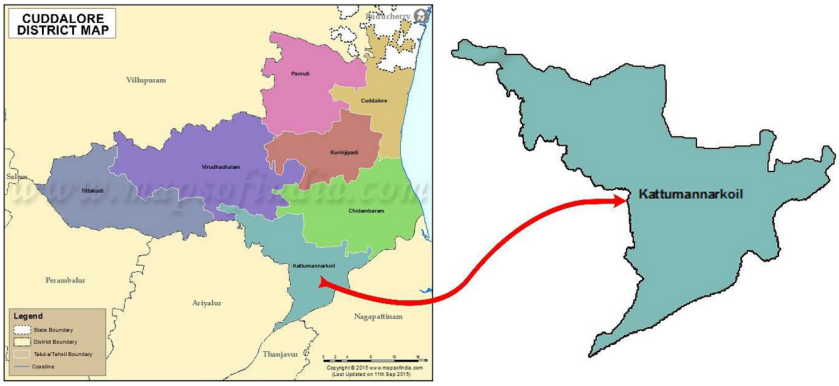

Fig. 1. Map of study area.

Where, Pi = ni/N; and ni=abundance of each species, N=total abundance of all species

Evenness index (Pielou 1977)

Evenness (E) =H / Log S
Where, H = Shannon weaver index; S= Number of species

Species richness (Pielou 1977)

Species richness is another mode of expression of the diversity and based on the total number of species and total number of individuals in a sample or habitat.

Richness index

D = S/√N
Where, 'D' is the index value, 'S' total number of species and 'N' total number of individuals of all species.

Simpson index (D) (Simpson 1949)

D = 1-Σ Pi2
Where Pi = proportion of individuals of species " i" divided by the total number of individuals in the sample and D = diversity of Simpson.

A weed seed bank study was conducted using tray method technique. A 1-kilogramme soil sample was taken using a 15 cm diameter metal core at various depths of 0-5, 5-10, 10-15, and 15-20 cm. Bulk soil samples were partially air dried before being broken up by hand. The soil samples that were taken were clearly labelled according to their depth. Separate samples were distributed in a nearly homogenous and uniform layer on a 30 × 20 x 5 cm plastic tray. Following that, regular watering was performed for 45 days. The number of germinated weed seedlings was counted under each soil depth for up to 45 days. Data on weed seedlings counted in weed seed bank were subjected to square-root (√X + 0.5) transformation before statistical analysis.

RESULTS AND DISCUSSION

A total of 16 species were found in the surveyed plots. Cyperaceae, the most typical weed family found in the phytosociological survey followed by Poaceae. In the survey among 12 species 7 monocots and 9 dicots were recorded. Among them the species belongs to monocot Cyperaceae and Poaceae are the most dominant weed species. According to the survey done in sedges *Cyperus rotundus, Cyperus difformis, Cyperus iria* in grasses *Echinochloa colonum, Echinochloa crusgali, Leptochloa chinensis* and in Broad leaved weeds *Eclipta alba, Bergia capensis, Marsilea quadrifolia, Ludwigia. parviflora, Sphenoclea zeylancia, Cyanotis axillaries, Commelina benghalensis, Monochoaria vaginalis* and *Cemtella asiatica* were the weeds recorded in the surveyed plots.

The data in Fig. 2 reflect the classifications of weeds, with sedges dominating (43.64%), grasses and broad leaf weeds accounting for (32.05% and 24.32%). Among the weeds identified, *C. rotundus, C difformis, E colonum* and *L. chinesis* were the most common weeds in the block's rice fields.

Table 1 shows several weed species and their relative dominance, density, and frequency values under the present environmental conditions. *C rotundus* had the highest relative dominance (20.28), density (17.23) and frequency (13.76) in the Kattumannarkoil block, followed by *E.colonum* (19.32), (16.08), (10.09). *C. asiatica* had the lowest relative dominance, density and frequency, namely (0.11), (0.09), (0.94).

C. rotundus, E. colonum, C. difformis and *L.*

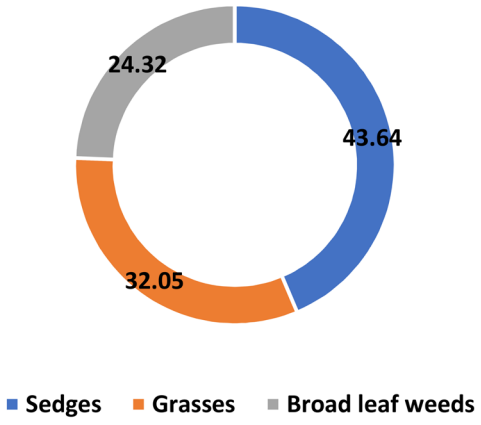

Fig. 2. Percentage distribution of weeds.

Table. 1. Relative dominance, relative density and relative frequency of weeds in low land rice fields of Kattumannarkoil block.

Weed sp.	Relative dominance	Relative density	Relative frequency
C. rotundus	20.28	17.23	13.76
C. difformis	17.44	13.79	10.09
C. iria	2.48	5.61	5.50
E. colonum	19.32	16.08	12.84
E. crusgali	4.18	5.40	6.42
L. chinensis	12.36	12.86	11.01
E. alba	10.01	9.94	8.26
M. quadrifolia	0.39	0.76	1.83
B. capnensis	4.01	6.80	7.34
S. zeylanica	3.42	5.01	7.34
F. miliaceae	2.87	4.72	4.59
M. vaginalis	0.25	0.14	1.83
L. parviflora	2.05	0.80	3.67
C. axillaries	0.38	0.15	1.83
C. bengalhensis	0.45	0.62	2.75
C. asiatica	0.11	0.09	0.94

Chinensis had the highest IVI values and are the most prevalent species in the examined weed community. *C. asiatica* had the lowest IVI levels. The IVI varied from 1.14 to 51.27 (Table 2). This shows that *C. rotundus* is the most predominant weed in Kattumannarkoil block followed by *C. difformis, E. colonum* and *L. chinesis*. The weed flora's density-based cluster analysis of Kattumannarkoil shows that several clusters among unique species, suggesting tighter density values, substantial relationships between various weed species and homogenous species distribution in their natural context.

The remarkable persistence of the most important weed species as progenitors in all phytosociological features could not be separated from their family's morphology and developmental characteristics. The Cyperaceae and Poaceae families comprised the majority of the weed species with the highest density, frequency, and abundance. These weeds are the most productive, producing hundreds of thousands of seeds in a single growing season. They reproduce by vegetative propagules, and their seeds share ecological similarities with crops and extended seed dormancy. Perennial weeds create the biggest problems in paddy fields since most of their seed banks remain in the soil, bringing up the next generation in the next cropping cycle. The eradication and management of weeds from the different cropping systems are major issues for farmers, different chemical, biological and mechanical techniques are applied to eradicate the weeds from agricultural farms, but successful weed management is only possible when the proper identification, characterization and lifecycle of weeds are extensively studied (Kushwuaha *et al*. 2018).

Weed seed bank

The data furnished in the Table 3 represents that highest weed density was recorded by sedges on both 30 and 45 days. The large number weeds identified in the study may be due to the presence of large seed bank deposited in the soil from previous years. Weeds have

Table 2. Importance value index (IVI) of weeds in low land rice fields of Kattumannarkoil block.

Weed sps	Common name	Family	Group	IVI
C. rotundus	Nut grass	Cyperaceae	Monocot	51.27
C. difformis	Umbrella sedge	Cyperaceae	Monocot	41.32
C. iria	Flat sedge	Cyperaceae	Monocot	13.59
E. colonum	Jungle rice	Poaceae	Monocot	48.24
E. crusgali	Barnyard grass	Poaceae	Monocot	16.00
L. chinensis	-	Poaceae	Monocot	36.23
E. alba	False daisy	Asteraceae	Dicot	28.21
M. quadrifolia	Pepper wort	Marsileaceae	Dicot	2.98
B. capnensis	-	Elatinaceae	Dicot	18.15
S. zeylanica	-	Sphenocleaceae	Dicot	15.77
F. miliaceae	Globe fringerush	Cyperaceae	Monocot	12.18
M. vaginalis	Pond weed	Monochoria	Dicot	2.22
L. parviflora	-	Ongraceae	Dicot	6.52
C. axillaries	-	Commelinaceae	Dicot	2.36
C. bengalhensis	Benghal day flower	Commelinaceae	Dicot	3.82
C. asiatica	Indian pennywort	Umbelliferae	Dicot	1.14

Table. 3. Density of weeds in soil seed bank. Note: Data subjected to square-root (√X+ 0.5) transformation; Figures in parentheses are original value.

Soil depth (cm)	At 30 Days			At 45 Days		
	Grasses	Sedges	BLW	Grasses	Sedges	BLW
0.-5	9.29	9.95	8.30	13.86	14.90	11.21
	(85.77)	(98.56)	(68.33)	(191.68)	(221.36)	(125.29)
5 -10	8.81	91.74	59.36	181.60	209.53	109.06
	(77.18)	(9.60)	(7.73)	(13.50)	(14.50)	(10.47)
10 -15	7.94	8.76	7.55	12.69	13.73	9.91
	(62.59)	(76.29)	(56.52)	(160.52)	(188.02)	(97.83)
15 -20	7.02	7.91	7.19	11.79	12.91	9.28
	(48.84)	(62.17)	(51.21)	(138.44)	(166.16)	(85.60)
LSD (P=0.05)	0.78	0.82	0.70	1.17	1.26	0.95

Table 4. Diversity indices values of weed flora in Kattumannarkoil block of Cuddalore district.

Shannon_H	2.17
Evenness index	1.81
Species richness index	2.68
Simpson's index	0.88

higher seed production so, they can easily disperse through many ways with variable dormancy resulting in germination by flushes over long period.

Diversity indices

The data represented in Table 4 clearly shows that Shannon's H index of weed flora diversity was found to be higher in the rice fields of Kattumannarkoil block (2.17). The evenness index (1.81) is very high it indicates that species are uniformly distributed in the cluster. Simpson index (0.88) indicated that the weed community is unlikely to be dominated by a few species. As a result, it was more diverse.

CONCLUSION

The study showed that *C. rotundus* had the highest relative dominance, density, and frequency, followed by *E. colonum* and *C. difformis*. However, *C. rotundus* had the highest IVI but the weeds from the Cyperaceae and Poaceae families are largely infesting the low-land rice fields of the Kattumannarkoil block. According to the weed seed bank study, many sedges weed seeds are present in the soil, followed by grasses. This shows that sedges and grasses are mostly infesting the rice fields.

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