Phytosociological association of weeds in rice based ecosystem

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ABSTRACT

Rice is an important staple meal for millions of people in Asia. However, severe weed infestation might cause significant yield loss. This study investigated weed composition in rice based ecosystem during kharif season 2021. The diversity of weed species in the fields were evaluated by using 0.25 cm² quadrat at randomly in ten different locations in each village, and the dominance, density, frequency and their related values were calculated. Among the weed species observed, the highest relative dominance, relative density, relative frequency and importance value index was observed with *Cyperus rotundus* which was followed by *Leptochloa chinensis* and *Cyperus difformis* in all the observed villages of rice fields. From the study, it could be concluded that special attention to manage *Cyperus rotundus* and other weed species are required using better weed management measures to reduce the yield losses in rice.

Key words: Rice, Weed survey, Importance value index.

Introduction

In India, rice is grown in an area of 463.79 lakh hectares, with an annual production of 130.29 million tonnes and a productivity of 2000.89 kg ha⁻¹ (Anonymous, 2023). In Tamilnadu, rice is cultivated in an area of 1.90 million hectares, producing 7.17 million tonnes with a productivity of 3.76 tonnes per hectare (India stat 2019-20). Being a staple food, it makes a large economic contribution to India and hence plays a crucial role in determining policy. Rice productivity suffers from various biotic and abiotic factors among them weeds pose a major threat (Yadav et al., 2018). The loss due to biological factors, weeds are known to account for one third. According to reports, weed infestation in transplanted rice causes a production drop upto 27.68 per cent in India (Hossain and Malik, 2017). The growth of weeds is largely influenced by the surrounding environment and farming practices. Moreover, selective control of weed species requires knowledge associated with a particular crop. Due to lack of knowledge about the most important weeds associated with rice and their phytosociological attributes might results in investing extra time and resources in control of weeds by the farmers at field level. Further, phytosociological study gives significant assessment of plants or weeds importance in a given area with fact and figures and also provides detailed information about species-wise distribution in ecosystem (Das, 2008). Hence, to build a sustainable weed control strategy, phytosociological studies of the local weeds of a
particular area are very helpful to understand the relationship between crop and their weed flora. In this context, the present study was conducted to determine the phytosociological characters of weeds in rice growing areas for efficient weed management in the rice ecosystem.

Materials and Methods

The current study was carried out on “Phytosociological association and diversity of weeds in rice based ecosystem in Chidambaram block, Cuddalore districts of Tamil Nadu”, to project the type of weed species that affects the rice ecosystem. The survey was conducted in rice fields of selected villages viz., Sivapuri, Vaiyur Varagoorpettai, Kumaramangalam and Kavarapattu of Chidambaram block during Kharif season 2021. Chidambaram block comes under veeranam command area of Tamil Nadu and rice is the predominant crop in this area. The climate is subtropical with an average rainfall varies from 1200-1500mm. Weed species compositions in the field were assessed by randomly placing 0.25 m² quadrants at 10 different locations in each village with the help of ‘handbook on weed identification’ (Naidu, 2012) and weed seed atlas (Naidu and Varshiney, 2007). To determine the various ecological characters like Relative dominance, Relative density, Relative frequency and IVI were arrived. Importance value index is valuable statistical tool for analysing the phytosociological data and plant community, since it gives a general understanding of a species and its role in the plant community. It is calculated by using the formula given by Mishra (1968)

\[
\text{Dominance (Do)} = \frac{\text{Total number of individual species}}{\text{Number of quadrants in which the species occurs}}
\]

\[
\text{Density (De)} = \frac{\text{Total number of individual species in all the quadrants}}{\text{Number of quadrants studied}}
\]

\[
\text{Frequency (F)} = \frac{\text{Number of quadrants in which the species occurs}}{\text{Number of quadrants studied}}
\]

\[
\text{Relative dominance (R. Do)} = \frac{\text{Dominance of a particular species}}{\text{Sum total of dominance of all species}} \times 100
\]

\[
\text{Relative density (R. De)} = \frac{\text{Density of a particular species}}{\text{Sum total of density of all species}} \times 100
\]

\[
\text{Relative frequency (R. F)} = \frac{\text{Frequency value for a species}}{\text{Total frequency value for all the species}} \times 100
\]

\[
\text{Importance value index (IVI)} = \frac{\text{R.Do} + \text{R.De} + \text{R.F}}{3}
\]

Results

Composition of weed species

Fifteen weed species belonging to nine families were found in all the different observation site of rice fields. Among the fifteen weed species the number of weed species belonging to monocot were nine (60 per cent), dicot were five (33.3 per cent) and one were Pteridophytes (6.25 per cent). Regarding lifecycle ten were annual, three were perennial and two were annual/ perennial. Among several categories of weeds, sedges were predominant in all five sites of rice fields followed by grasses and broad leaved weeds (Table 1).

Dominance, Density and Frequency

The dominance, density and frequency of several weed species in rice fields were presented in Table 2. From the study, the weed dominance value in Sivapuri ranges from (1.44 to 12.98), Vaiyur (1.47 to 11.32), Varagoorpettai (1.76 to 14.33), Kumaramangalam (1.20 to 11.90) and Kavarapattu (0.40 to 14.3). Among the weed species recorded, *Cyperus rotundus* have highest dominance value in Sivapuri (12.98), Varagoorpettai (14.33) and Kavarapattu (14.37) while in Vaiyur (11.32) and Kumaramanagalm (11.95) the highest dominance was observed with *Leptochloa chinensis*. The lowest dominance value of (1.44) *Cyanotis axillaris* was observed in Sivapuri and this weed species was not occurred in remaining four villages studied.

Similarly, the weed species *Cyperus rotundus* showed highest density in all the observation sites viz., Sivapuri (12.9), Vaiyur (9.4), Varagoorpettai (14.0), Kumaramangalam (9.2) and Kavarapattu (13.9) which was followed by *Leptochloa chinensis*. The lowest density value of (0.5) *Cyanotis axillaris* was recorded in Sivapuri and this weed species was not observed in remaining four villages.

Further, the weed species *Cyperus rotundus* recorded the highest frequency of weed population in all the five villages. While in Sivapuri, Varagoorpettai and Kavarapattu villages the highest frequency of 0.9, 0.8 and 0.9 respectively, was observed with *Leptochloa chinensis* and with *Echinochloa crusgalli* in Vaiyur and Kumaramangalm. The minimum frequency value of 0.2 was recorded with *Cyanotis axillaris* in Sivapuri and this weed species was not occurred in the remaining four villages, while in Vaiyur and
Kumaramangalam the minimum frequency was recorded with *Commelina benghalensis*. In Varagoorpettai village *Commelina benghalensis* (0.2) and *Sphenoclea zeylanica* (0.2) were observed and in Kavarapattu it was observed with *Sphenoclea zeylanica* (0.1).

**Relative dominance, Relative density, Relative frequency**

The relative dominance, relative density, relative frequency and Important value index value of rice field was presented in Table 3.

The highest relative dominance was observed with *Cyperus rotundus* (13.24, 14.77 and 14.95 in Sivapuri, Varagoorpettai and Kavarapattu, respectively) and *Leptochloa chinensis* (17.13) and *Kumaramangalam* (18.56). The lowest relative dominance value (1.46) of *Cyanotis axillaris* was observed with sivapuri and this weed species was not observed in all other villages studied. The lowest relative dominance value was recorded with *Echinochloa colona* in Vaiyur (2.22) and Kumaramangalam (1.87), and the *Commelina benghalensis* in Varagoorpettai (1.81) and Kavarapattu (0.41).

Further, the highest relative density was observed with *Cyperus rotundus* (19.08, 20.75, 18.00, 21.44 and 19.35 in Sivapuri, Vaiyur, Varagoorpettai, Kumaramangalam and Kavarapattu, respectively). The lowest relative density value at Sivapuri (0.73) was recorded with *Cyanotis axillaris* and this weed was not observed in the remaining villages. However, the lowest relative density value was recorded with *Commelina benghalensis* (1.41) in Varagoorpettai, while in Kumaramangalam and Vaiyur the lowest relative density was recorded with *Sphenoclea zeylanica* (0.66 and 0.93, respectively) and in Kavarapattu it was observed with *Echinochloa colona* (0.69).

The highest relative frequency values indicate more prevalence and lower relative frequency indicate less prevalence of weed species. Among the weeds recorded, the highest relative frequency was observed with *Cyperus rotundus* (11.76, 12.82, 11.84, 12.04 and 11.71 at Sivapuri, Vaiyur, Varagoorpettai, Kumaramangalam and Kavarapattu respectively). The lowest relative frequency value at Sivapuri was recorded with *Echinochloa colona* (2.35) and *Cyanotis axillaris* (2.35) and *C. axillaris* was not observed in remaining four villages. The lowest relative frequency was recorded with *Commelina benghalensis* in Vaiyur (1.28) and Kumaramangalam (1.20) while in Kavarapattu (1.17) and Varagoorpettai (2.63) it was recorded with *Sphenoclea zeylanica*.

**Importance value index (IVI)**

Importance value index, shows that the highest IVI was observed with *Commelina benghalensis* (14.69, 15.93, 14.80, 16.53 and 15.34 in Sivapuri, Vaiyur, Varagoorpettai, Kumaramangalam and Kavarapattu, respectively). It was followed by *Leptochloa chinensis* and *Cyperus difformis* registered higher IVI in all the study area. The lowest IVI (1.52)
Table 2. The Dominance (Do), Density (De) and Frequency (F) of different weed species in rice crop at the observation sites

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Scientific name</th>
<th>Sivapuri</th>
<th>Vaipyr</th>
<th>Varagoorpettai</th>
<th>Kumaramangalam</th>
<th>Kavarapattu</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Bergia capensis</td>
<td>6.83</td>
<td>4.2</td>
<td>0.6</td>
<td>4.13</td>
<td>2.6</td>
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<tr>
<td>2</td>
<td>Commelina benghalensis</td>
<td>3.75</td>
<td>1.2</td>
<td>0.3</td>
<td>2.24</td>
<td>0.3</td>
</tr>
<tr>
<td>3</td>
<td>Cyanotis axillaris</td>
<td>1.44</td>
<td>0.5</td>
<td>0.2</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>Cyperus difformis</td>
<td>11.21</td>
<td>9.8</td>
<td>0.8</td>
<td>8.12</td>
<td>6.1</td>
</tr>
<tr>
<td>5</td>
<td>Cyperus iria</td>
<td>6.74</td>
<td>3.5</td>
<td>0.6</td>
<td>5.45</td>
<td>2.5</td>
</tr>
<tr>
<td>6</td>
<td>Cyperus rotundus</td>
<td>12.98</td>
<td>12.9</td>
<td>1.0</td>
<td>9.43</td>
<td>9.4</td>
</tr>
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<td>7</td>
<td>Echinochloa colona</td>
<td>4.58</td>
<td>0.8</td>
<td>0.2</td>
<td>1.47</td>
<td>0.4</td>
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<td>8</td>
<td>Echinochloa crusgalli</td>
<td>9.45</td>
<td>7.7</td>
<td>0.8</td>
<td>5.00</td>
<td>4.6</td>
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<td>Eclipta alba</td>
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<td>5.3</td>
<td>0.7</td>
<td>5.45</td>
<td>4.2</td>
</tr>
<tr>
<td>10</td>
<td>Fimbristylis milacea</td>
<td>4.25</td>
<td>1.9</td>
<td>0.4</td>
<td>2.59</td>
<td>1.0</td>
</tr>
<tr>
<td>11</td>
<td>Leptochloa chinensis</td>
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<td>10.7</td>
<td>0.9</td>
<td>11.32</td>
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<td>Marsilea quadrifolia</td>
<td>6.27</td>
<td>4.8</td>
<td>0.7</td>
<td>5.00</td>
<td>4.0</td>
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<td>14</td>
<td>Monochoria vaginalis</td>
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<tr>
<td>15</td>
<td>Sphenoclea zeylanica</td>
<td>3.51</td>
<td>1.4</td>
<td>0.3</td>
<td>2.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Table 3. Relative dominance (R.Do), Relative density (R.De), Relative frequency (R.F) and IVI of weed species in rice crop at the observation sites

<table>
<thead>
<tr>
<th>S. No.</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Bergia capensis</td>
<td>6.96</td>
<td>6.21</td>
<td>7.05</td>
<td>6.74</td>
<td>6.65</td>
</tr>
<tr>
<td>2</td>
<td>Commelina benghalensis</td>
<td>3.82</td>
<td>1.77</td>
<td>3.52</td>
<td>3.04</td>
<td>1.75</td>
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<tr>
<td>3</td>
<td>Cyanotis axillaris</td>
<td>1.46</td>
<td>0.73</td>
<td>1.52</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>Cyperus difformis</td>
<td>11.43</td>
<td>14.49</td>
<td>9.18</td>
<td>12.29</td>
<td>8.97</td>
</tr>
<tr>
<td>5</td>
<td>Cyperus iria</td>
<td>6.87</td>
<td>5.17</td>
<td>7.05</td>
<td>5.41</td>
<td>5.24</td>
</tr>
<tr>
<td>6</td>
<td>Cyperus rotundus</td>
<td>13.24</td>
<td>19.08</td>
<td>11.76</td>
<td>14.22</td>
<td>12.82</td>
</tr>
<tr>
<td>7</td>
<td>Echinochloa colona</td>
<td>4.59</td>
<td>1.18</td>
<td>2.35</td>
<td>2.70</td>
<td>2.31</td>
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<td>Echinochloa crusgalli</td>
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<td>3.78</td>
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<td>6.39</td>
<td>7.10</td>
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<td>10.25</td>
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<td>14</td>
<td>Monochoria vaginalis</td>
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<td>3.99</td>
<td>4.61</td>
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<td>3.58</td>
<td>2.07</td>
<td>3.52</td>
<td>3.06</td>
<td>2.56</td>
</tr>
</tbody>
</table>
Discussion

The data above clearly showed that Cyperus rotundus was the most commonly distributed weed species in all the sites investigated. This weed was found to be the most perponderance weed in rice fields during kharif season. As purple nutsedge (Cyperus rotundus) is a serious weed in rice (Kadir and Charudattan, 2000), and one of the worst weed in tropical and subtropical regions of the world (Dor and Hershenhorn, 2013). A single tuber can produce around 1200 tubers within 3 months and have longevity of about 17 months (Gilreath and Santos, 2004). The tendency to regenerate via seeds, rhizomes, tubers and basal bulbs also contributes its widespread distribution. Its propagules remain dormant for longer periods, allowing it to survive throughout the year, and these features offer it an advantage over other weed species (Perveen et al., 2008; Henry et al., 2021). Further, the weed species that have high importance value index were more competitive than other weed species (Travlos et al., 2018). As this weed have greater capacity to withstand adverse conditions and remain dormant for certain period of time. Once it attain favourable condition it will germinate and produce more number of seeds. Being a perennial weed is very difficult to control, it might be due to weed seed bank of soil.

Conclusion

From the study, it could be concluded that Cyperus rotundus recorded the highest importance value index which was followed by Leptochloa chinensis and Cyperus difformis. The other weeds occurred in varying degrees. The preponderance of Cyperus rotundus impart the need for managing this weed. Further, the results of the study could help in strategic management of weeds in rice.

References


