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# Phytosociological Examination of Weed Flora in Cotton Cultivations in Shrirampur and Rahuri Tehsils

*Miss Vrushali Ashokrao Jondhale*
*Dr S. P. Giri*
*Padmashri Vikhe Patil College of Arts, Science and Commerce*
*Pravaranagar, Post: Loni-413713,*
*Tal: Rahata, Dist: Ahilyanagar, Maharashtra, India.*

**Abstract**

The current study was conducted to look at the composition and distribution of weed species linked with cotton farming in selected agricultural fields in the Shrirampur and Rahuri tehsils of Ahmednagar district, Maharashtra. The study concentrated on phytosociological weed flora metrics such as frequency, relative frequency, density, relative density, abundance, relative abundance, dominance, and Important Value Index (IVI) in cotton crop ecosystems. During the cropping season, field surveys were done to record weed species and their occurrence patterns using the random quadrat sampling method. Weed collection took place between 2019 and 2025, whereas phytosociological study used a random quadrat sample approach from 2020 to 2022. The obtained data demonstrated the presence of different monocotyledonous and dicotyledonous weed species that impair cotton productivity. Several major weeds had greater frequency and density values, indicating excellent adaptability to local agro-climatic conditions. The study found significant variance in weed composition between the two tehsils due to changes in soil properties, irrigation procedures, and agricultural management approaches. Dominant weed species were shown to compete heavily with cotton plants for nutrients, moisture, sunlight, and space, resulting in reduced crop growth and output. The study emphasizes the value of phytosociological assessment in understanding weed dynamics and designing efficient weed management strategies in cotton agriculture. The results of this study may lead to sustainable agriculture practices and enhanced cotton productivity in the region.

***Keywords: Weed, Weed Management, Weed Composition, Weed Distribution, Agricultural Fields, Frequency, Density, Abundance, Dominance, Cotton Crop***

## 1. Introduction

Cotton is currently the world's leading plant fibre crop, and one of India's most important commercial crops. Farmers in the study area cultivate various cotton kinds. Weeds provide a significant challenge in crop production(Paslawar et al., 2015). In India, weeds are a major issue in crop production. In general, the infestation of a significant number of weeds in crop fields results in heavy yield losses to commercial crops. Crop plants compete for space, water, and nutrients more efficiently, which leads to crop production declines and significant economic losses(Navagana, 2017).

Weeds fight for ace, water, and nutrients, frequently more efficiently, resulting in crop production losses. Weeds have a larger competitive ability than agricultural plants and influence the optimal quantities of mineral nutrients and moisture more efficiently, allowing them to thrive in drought conditions. They shade agricultural seedlings and take up area where crop plants should spread their roots(Nalini & Chinnusamy, 2019). Weeds need more resources than crop plants; they grow quicker and absorb nutrients more efficiently, so restricting the availability of the same to crop competitive ability of weeds crucially effects the optimum crop yields(Chavhan et al., 2023). Weeds consume mineral nutrients and moisture more efficiently than agricultural plants, and they thrive under drought circumstances. They shade the crop seedlings and take up area where crop plants should grow their roots(Pawar et al., 2022).

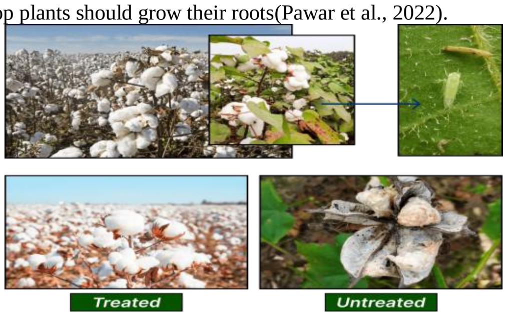


Figure 1 Maximizing Crop Yield and Weed Control

Figure 2 Common weeds in cotton

Weeds demand more content than agricultural plants; they grow quicker and absorb nutrients more effectively, limiting their availability to crop plants. Furthermore, weeds cause allelopathic impacts on crop plants, primarily through their depressed root exudates. Reduction in agricultural yield is directly related to the use of current mechanical technologies(Nirgundikar et al., 2024). Furthermore, weeds cause allelopathic impacts on crop plants, primarily through their depressed root exudates. Weed competition is directly related to reduced agricultural output(Ramprakash et al., 2024).

Despite the fact that contemporary mechanical methods have been used in weed management programs for several decades, weeds continue to be a key limiting issue in agricultural cultivation and productivity worldwide(Singh & Garg, 2022). Weeds continue to be a major limiting issue in agricultural production and productivity worldwide, accounting for a significant portion of the total annual loss of agricultural produce caused by various weed management programs during the last several decades(Yenpreddiwar et al., 2023).

Maharashtra's cotton agroecosystems are home to a diverse range of weed species because of the state's ideal climate, irrigated agricultural methods, and nutrient-rich soils(Devi et al., 2024). Weed communities are dominated by both monocot and dicot species, including *Parthenium hysterophorus, Cynodon dactylon, Cyperus rotundus, Amaranthus viridis, Digera muricata, and Echinochloa colona,* according to phytosociological research done in the state's many cotton-growing districts(Madavi et al., 2017). These species show excellent adaptation and aggressive development behavior in cotton fields, as evidenced by their high Importance Value Index (IVI), frequency, density, and abundance values(Vasave et al., 2025). In Maharashtra, quadrat-based phytosociological analysis has been extensively employed to comprehend weed composition and dispersion patterns, which differ dependent on crop management techniques, soil type, irrigation intensity, and rainfall(Madavi et al., 2017).

Crop productivity and farm economics are greatly impacted by weed infestation in cotton fields. Reduced plant growth and productivity result from dominant weeds competing with cotton plants for vital resources like nutrients, water, sunlight, and space(Parmar et al., 2024). Due to their rapid growth rate and allelopathic effects, which inhibit crop plant germination and growth, species like *Parthenium hysterophorus and Cynodon dactylon* are especially dangerous(Varsha et al., 2019). Because heavy weed pressure necessitates frequent weeding and herbicide application, it also raises agriculture costs. Furthermore, some weeds serve as substitute hosts for diseases and insect pests, which further compromises the productivity and health of cotton(Rathod et al., 2023).

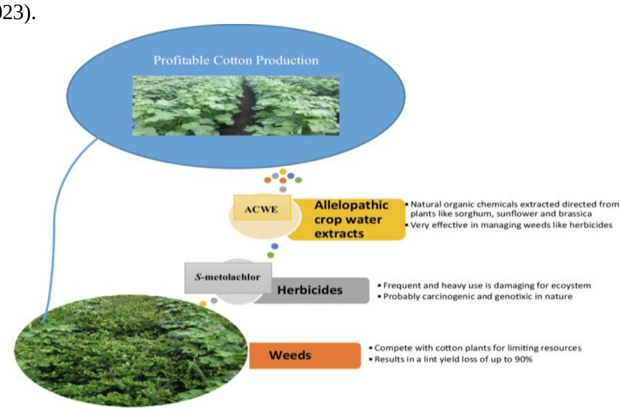


Figure 3 Weeds and their management in cotton

Weed flora offers some ecological advantages despite their detrimental effects on agriculture. By preventing erosion and preserving soil cover during times when crops are not being grown, weeds help safeguard the soil. When they decompose, several weed species give organic matter to the soil, increasing its fertility(Shinde et al., 2026). Additionally, they sustain biodiversity in agroecosystems by providing food and habitat for insects, birds, and other

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species. Weeds serve as crucial markers of environmental factors such soil fertility, moisture content, and disturbance patterns in phytosociological research(Mane et al., 2023). Developing sustainable and integrated weed management techniques that strike a balance between crop yield and ecosystem stability is made easier by an understanding of their distribution and ecological roles(Varsha et al., 2019).

The study of all occurrences and effects related to the social life of plants is known as phytosociology. When a plant is in close proximity to a weed, it may react by failing to survive through plastic development. Quantitative correlations between the plant species that flourish in a given area can be analyzed to determine the community's structural characteristics(H. F. Patel et al., 2022). Effective management of weeds in agricultural fields requires an understanding of their sociological structure. A thorough understanding of weed dominance because to ecological assessments of plant flora. Developing effective weed management techniques requires knowledge on the type and degree of weed flora infestation in an agroecosystem obtained from weed surveys(Marimuthu, 2021). Various strategies can develop for weed management techniques in significant crops that marginal farmers can adopt by identifying and quantifying the weed species found in various crop cultures and cropping systems(Varsha, 2020). Knowing the quantitative characteristics of particular species, such as density, frequency, and significance value, is crucial because all weed species have a significant role in determining the nature of weed communities(Nagargade et al., 2024).

The quantitative evaluation of plant communities using metrics like frequency, density, abundance, and Importance Value Index (IVI) is part of the phytosociological analysis of weed flora in cotton fields. This method aids in determining the composition, structure, and pattern of dominance of weed species in the cotton ecosystem(Navagana, 2017). Such studies consistently show a weed community dominated by aggressive and rapidly growing species such as *Parthenium hysterophorus, Cynodon dactylon, Cyperus rotundus, Amaranthus spp., and Digera muricata,* which exhibit high IVI values and broad ecological adaptability in cotton-growing regions of Maharashtra and other parts of India(Chavhan et al., 2023).

Phytosociological assessment has important implications for scientific knowledge and agricultural management. It gives precise details regarding weed species that are problematic and dominating, their geographic range, and how much they compete with cotton crops(Kamble & Danawale, 2017). Strong infestation pressure is indicated by high frequency and density values of some weeds, which directly impact crop growth by competing for nutrients, water, light, and space. Repeated weed management methods frequently lead to lower cotton yields and higher production expenses(Ramprakash et al., 2024). Furthermore, phytosociological research emphasizes how invasive weeds affect the diversity of native plants and the equilibrium of ecosystems. All things considered, phytosociological analysis is essential to comprehending the ecology of weeds in cotton fields and aids in the creation of focused and efficient weed control techniques, which raise crop yields and guarantee sustainable farming methods(Anand et al., 2022).

## 2. Literature Review

Due to its substantial influence on crop yield and ecosystem balance, weed flora in cotton agroecosystems has been extensively researched. Numerous monocot and dicot weed species thrive in cotton fields and fiercely compete with the crop for nutrients, water, light, and space(M. M. Patel et al., 2024). According to earlier studies, fast-growing, invasive species frequently take over cotton fields, which lowers production and raises management expenses(Sharma & Jadhav, 2024). Weed communities differ according on soil type, irrigation techniques, and agronomic management, according to studies from several regions of India, including Maharashtra. However, there aren't many studies on the ecology of weeds in the cotton fields in Rahuri and Shrirampur tehsils. In order to better understand species composition and dominance patterns for efficient weed control tactics, the current work focuses on the phytosociological analysis of weed flora in these areas.

P. P. Shinde, [2026] emphasizes sustainable farming methods, weed control, and crop production. The author has made a substantial contribution to the planning, analysis, and interpretation of the research. Agronomic techniques, soil management, and increasing crop productivity under various farming situations are among their areas of competence. Crop management and sustainable farming systems are the author's areas of expertise in agricultural research. They have helped with statistical analysis, manuscript preparation, and general research coordination. The author has contributed to data documentation, experimental support, and material preparation. Integrated crop management and the application of agricultural technologies at the field level are among their areas of interest. The author has helped with technical support, literature review, and data compilation.

JB Vasave, [2025] investigation of cotton (Gossypium hirsutum L.) important crop-weed competition in south Gujarat. A randomized block design with three replications and twelve distinct critical crop weed competition treatments were used. Plant height, number of sympodial branches per plant, number of bolls per plant, boll weight, seed cotton yield, and stalk yield were all considerably higher for the treatment W6 (Weed free up to harvest) in both years and in pooled results. Under the weed-free up-to-harvest treatments (W6), the maximum weed control efficiency and minimum weed index were also notably recorded in both years and in the pooled data. Higher plant height, number of sympodial branches per plant, number of bolls per plant, boll weight, seed cotton yield and stalk yield, weed control efficiency, and weed index were all demonstrated by the treatments W5 (weed free up to 75 DAS), W4 (weed free up to 60 DAS), and W7 (weedy up to 15 DAS). Growth parameters, yield attributes and yields parameters, weed index, and weed control efficiency were all lower for treatment W12 (Weedy up to harvest) in both years and in pooled findings. The weed index for 2020–2021 (40.40%), 2021–2022 (43.13%), and the aggregated findings (41.77%) under treatment W12 (Weedy up to harvest) shows the percentage decrease in seed cotton yield as a result of significant weed infestation in comparison to a weed-free plot.

Meher Nirgundikar, [2024] researched on these species in this region unequivocally demonstrates that Senna uniflora and Chromolaena odorata are the predominant weeds, potentially endangering the variety of native plants. With values ranging from 2.10 to 3.16 and 0.84 to 0.93, respectively, vegetation indices including the Shannon index and Simpson index verified their aggressiveness and invasiveness. The results of this study shed light on the distribution patterns of invasive and native weeds in Maval as well as how they interact with environmental elements. These findings may be a valuable resource for weed control and upcoming studies.

Presha M. Parmar, [2024] Ten treatments and three replications were used in the randomized block design experiment. Plant height, monopodial and sympodial branches/plants, yield per plant, and seed cotton yield were all considerably greater in the weed-free plot. This was followed by pyrithiobac sodium + quizalofop ethyl 100 (60 + 40) g/ha as PoE at 25 DAS + IC fb HW at 50 DAS, which remained comparable to the weed-free treatment. When compared to all other treatments, these two had the lowest monocot, dicot, and overall weed densities at 25, 50, and 75 DAS. In comparison to all weed management treatments, the weedy check plot had the shortest plants, the fewest monopodial and sympodial branches/plants, the yield per plant, and the seed cotton yield. Maximum monocot, dicot, and total weed densities were found in the weedy check plot at 25, 50, and 75 DAS. The weed-free plot produced the highest gross return (186735/ha), whereas the pyrithiobac sodium + quizalofop ethyl 100 (60 + 40) g/ha as PoE at 25 DAS + IC fb HW at 50 DAS produced the highest net returns and B:C ratio (112391/ha and 2.62, respectively). The results showed that, in North Gujarat, applying pyrithiobac sodium + quizalofop 100 (60+40) g/ha as PoE at 25 DAS + IC fb HW at 50 DAS efficiently reduced weeds in Bt cotton and increased seed cotton yield and net return.

T. Ramprakash, [2024] research showed that weed management practices CA systems affected the physical, chemical, and biological characteristics of the soil. It was discovered that CA improved physical characteristics such aggregation, bulk density, soil structure, and hydraulic conductivity, which improved porosity, root growth, and water infiltration. By lowering electrical conductivity, raising cation exchange capacity, improving SOC, and regulating soil pH, CA-based weed suppression improved nutrient retention. In CA-based cotton systems, reliance on herbicides has been demonstrated to affect soil microbial diversity and enzyme activity, depending on the type and frequency of application of the herbicide. Certain herbicides momentarily impede the activities of soil microorganisms and enzymes (such as phosphatases, urease, and dehydrogenase). On the other hand, soil microbial biomass carbon (SMBC) and microbial activity were positively impacted by mulching and organic residue retention in CA systems. By sequestering CO2 in SOC, CA techniques progressively sequestered carbon, stabilizing it and promoting biodiversity.

M. M. Patel, [2024] Examine the effects of six treatments for integrated weed control in cotton: weedy check (T1), weed-free check by hand weeding (T2), application of Pendimethalin 30% EC @ 1 kg a.i./ha as pre-emergence + hand weeding at 30 and 60 days after sowing (T3), application of Pendimethalin 30% EC @ 1 kg a.i./ha as pre-emergence followed by Pyrithiobac sodium 10% EC @ 62.5 g a.i./ha (Tank mixture) at 30 days after sowing (T4), T4 + one interculturing and hand weeding at 60 days after sowing (T5). 60 days after sowing (T6) under irrigated conditions, 24% SL plus one interculturing and hand weeding. Four replications and a Randomized Block Design were used to set up the experiment. The findings showed that two hand weeding at 30 and 60 days after sowing, three hand weeding at 30, 60, and 90 days after sowing, and the application of Pendimethalin at 1 kg a.i./ha as pre-emergence were effective in improving growth, yield attributes, and seed cotton yield while decreasing the dry weight of weeds.

N. S. Rathod, [2024] The experiment was carried out in Central Farm, VNMKV, Parbhani (MS) in Kharif 2021. comprised three population densities (24,691 plants ha-1 (D1), 37,037 plants ha-1 (D2), and 55,555 plants ha-1 (D3) as well as weed control techniques: pre-emergence pendimethalin application followed by two hand weeding and one hoeing (W1), pre-emergence pendimethalin followed by post-emergence pyrithiobac-sodium 60% + quizalofop-ethyl (75+50 g ha-1) (W2), post-emergence pyrithiobac-sodium + quizalofop-ethyl followed by one hand weeding (W3), and Weedy check (W4) in split plot during replication three. The application of pyrithiobac-sodium + quizalofop-ethyl (20-25 DAS) followed by 40 days hand weeding recorded more seed cotton yield (2019 kg ha-1), net monetary returns (Rs. 1,22,678 ha-1), and benefit cost ratio (2.47) was observed with higher weed control efficiency (56.59%) and significantly higher than other treatments of weed control plant density of 55,555 plant ha-1 (90 cm x 2).

K. R. Chavhan, [2023] The experiment was set up in a Randomized Block Design (RBD) and replicated three times with eight treatments: T1 Weedy check, T2 Weed free, T3 Pendimethalin 30EC (pre-emergence)@0.50kg a.i./ha, T4 Quizlofop-ethyl 5% EC (post-emergence) 50g a.i./ha. at 20 DAS, and T5 Sodium Acifluorfen16.5% + Clodinafop-propargyl 8% (premix) @ 100 g.a.i./ha. at 20 D@ 0.50 kg a.i./ha. + Hand weeding at 20DAS., T7 Pendimethalin 30EC (pre-emergence) @ 0. 50 kg a.i./ha. + Quizlofop-ethyl 5% EC (post-emergence) 50g a.i./ha. at 20 DAS., T8 Pendimethalin 30EC (pre-emergence) @ 0. 50 kg a.i./ha. + Sodium Acifluorfen 16.5% + Clodinafop-propargyl 8% (premix) @ 100 g.a.i./ha. at 20 DAS.Based on the pooled results, it is determined that pre and post-emergence herbicide for chemical weed management in sesame, the seed yield was found to be substantial. Pre-emergence application of Pendamethalin 30 EC @ 0.50 kg a.i./ha + hand weeding at 20 DAS was an effective and economically feasible package to manage the weeds and realize better returns. The treatment T2 (weed free) crop produced the significantly highest seed yield (607 kg/ha, Net Monetory Returns Rs. 42730/-, and B:C Ratio 2.93) over the rest of treatments.

M.D. Yenpreddiwar, [2023] demonstrated that the weed-free control treatment outperformed the other treatments in terms of plant height, dry weight per plant, number of bolls per plant, boll weight, and cotton seed output. Additionally, it was the most effective at controlling weeds. Second place went to pendimethalin 38.7 CS PE 1.25 a.i. kg ha-1 + hoeing at 30 DAS + manual weeding at 45 DAS. Consequently, under the weed-free check and pendimethalin + cultural practices treatments, seed cotton and lint yields were equal. From an economic perspective, the use of pendimethalin (38.7 CS PE 1.25 a. i. kg ha-1), weed free check, hoeing at 30 DAS, and manual weeding at 45 DA all resulted in higher gross and net return values.

S. G. Mane, [2023] revealed that high density planting (90 cm x 45 cm) produced the highest AGR for plant height. The maximum AGR for plant height (1.664 cm day-1 plant-1) was observed between 61 and 90 DAS, but the mean maximum AGR for dry matter (2.358 g day-1 plant-1) was recorded between 91 and 120 DAS under high density planting (120 cm x 45 cm). The mean maximum AGR for plant height (1.645 cm day-1 plant-1) was observed between 61 and 90 DAS for weed-free treatment, whereas the mean maximum AGR for dry matter (2.441 g day-1 plant-1) was reported between 91 and 120 DAS. Additionally, with weed-free treatment, the mean CGR, RGR, and LAI were at their highest.

Kamble Anand Shankar, [2022] The experiment was conducted in 2017–18 and 2018–19. Pre-emergence applications of Clomazone 50 EC at 250, 500, and 750 g a.i./ha in contrast to pendimethalin 37.5 CS@680 g a.i./ha, post-emergence applications of pyrithiobac sodium 10 EC and quizalofop ethyl hand weeding at 25 DAS, intercultivation at 50 and 75 days after sowing, and weed-free. A randomized block design with triple replication was used to set up the experiment. The results showed that using Clomazone 50 EC @ 250 g a.i./ha was beneficial in controlling weeds and increasing seed cotton yield (38.5%). It resulted in better weed management, reduced weed uptake of nitrogen, and boosted crop uptake of nutrients. In terms of uptake and losses, it also results in the fewest nutrient losses. Clomazone 50 EC @ 250 g a.i/ha was shown to be the most effective application for controlling weeds in cotton, followed by pyrithiobac sodium 10 EC @ 75 g a.i./ha + Quizalofop ethyl 5 EC @ 75 g a.i./ha at 25 DAS.

N. Varsha, [2019] The design of the experiment was a randomized block design that was repeated three times. Polymulch applications and mechanical weeding three times at 20, 40, and 60 DAS decreased weed growth in both red and black soils. Among the herbicides, diuron at 1.0 kg/ha fb pyrithiobac-sodium + quizalofop-ethyl in red soil and both diuron at 1.0 kg/ha and 0.75 kg/ha in conjunction with successive herbicide applications decreased weed density. With the exception of itch grass, diuron could eliminate broad-leaved weeds and grasses. Diuron is similarly unable to reduce sedges. Herbicidal treatments, such as diuron at 1.0 and 0.75 kg/ha fb pyrithiobac-sodium + quizalofop-ethyl, produced the lower weed persistence index values. When polymulch and mechanical weeding were used three times at 20, 40, and 60 DAS, the crop resistance index and treatment efficiency index were higher.

B. Madavi, [2017] In order to assess four planting densities (55,555 plants ha-1, 1,11,111 plants ha-1, normal planting, and paired row planting, 1,48,148 plants ha-1) and four weed management techniques (pendimethalin 1.0 kg ha-1 as PE fb pyrithiobac sodium 62.5 g ha-1+quizalofop-p-ethyl 50 g ha-1 at 15 DAS fb glyphosate ammomium salt 2.13 kg ha-1 at 45 DAS). The yield of kapas was considerably higher at a plant density of 1,11,111 plants ha-1 (60 cm × 15 cm) (3134 kg ha-1), Pre-emergence application of pendimethalin 1.0 kg ha-1 fb PoE tank mix application of pyrithiobac sodium 62.5 g ha-1+quizalofop-p-ethyl 50 g ha-1 at 20, 40, and 60 DAS recorded higher kapas yield (3119 kg ha-1) and ginning percentage compared to two other weed management techniques. Plant densities had no effect on the seed index, ginning percentage, or lint index.

Nagaraju Navagana, [2017] In order to determine the weed flora, species composition, density, frequency, and significance value index (IVI), a survey of the weeds growing in cotton crop fields in the 43 mandals of the Visakhapatnam district was conducted. In the research area's cotton fields, a number of plant species from 45 genera and 21 families have been identified. With ten weed species, Asteraceae was the largest of the 21 families. Euphorbiaceae came in second with seven species, followed by Poaceae (five) and Cyperaceae (four). The results of phytosociological investigations revealed that fields in the study region. Asteraceae was the largest weed family among 21 families, with 10 species; Euphorbiaceae, with 7 species, was the second largest weed family, followed by Poaceae (5) and Cyperaceae (4). Phytosociological studies were conducted to determine the weed flora, species composition, density, frequency, and importance value index (IVI) in the 43 mandals of the Visakhapatnam district. The results showed that (3.10) was the most abundant species, followed by Chromoleana Phyllanthus debilis odorata Cotton is one of the most important commercial crops. In the research area's cotton fields, 55 distinct plant species from 45 genera and 21 families have been identified. With ten weed species, Asteraceae was the largest of 21 families, followed by Euphorbiaceae with seven species, Poaceae (five), and Cyperaceae (four). The most prevalent species, according to phytosociological research, was Phyllanthus debilis (3.10), followed by Odorata (3.0) and Celosia argentea (2.6). Chenopodium album (9.44) was the most significant species found in the cotton crop areas, followed by Phyllanthus maderaspatensis (8.62), according to Phyllanthus amarus (2.6) and Value Indiex (IVI). Order and Cleome viscosa (8.03).

Table 1 Comparative Table for Previous Research Done

| Author | Year | Methodology | Key Results | Research Gap |
|---|---|---|---|---|
| P. P. Shinde | 2026 | Research focused on crop production, weed management, soil management, and sustainable agricultural practices involving data analysis, field experimentation, manuscript preparation, and integrated crop management approaches. | Emphasized improvement of crop productivity through sustainable farming systems, agronomic practices, and integrated crop management technologies. | Lack of specific experimental data, treatment comparisons, and quantified outcomes related to weed management in cotton. |
| JB Vasave | 2025 | Randomized Block Design (RBD) with 12 critical crop-weed competition treatments and 3 replications under South Gujarat conditions. | Weed-free up to harvest (W6) recorded maximum plant height, boll number, boll weight, seed cotton yield, stalk yield, and weed control efficiency. Weedy up to harvest (W12) resulted in maximum yield loss and weed index. | Study focused mainly on critical competition periods; economic analysis and long-term soil health effects were not explored. |
| Presha M. Parmar | 2024 | RBD with 10 treatments and 3 replications evaluating herbicide combinations and integrated weed control methods in Bt cotton. | Weed-free treatment and pyrithiobac sodium + quizalofop ethyl followed by interculturing and hand weeding significantly improved growth, weed suppression, seed cotton yield, net returns, and B:C ratio. | Long-term environmental impact and herbicide resistance development were not addressed. |
| T. Ramprakash | 2024 | Review/research on weed management practices under Conservation Agriculture (CA) systems focusing on soil physical, chemical, and biological properties. | CA improved soil structure, aggregation, hydraulic conductivity, SOC, microbial biomass, and carbon sequestration, though herbicide use affected microbial diversity and enzyme activity. | Limited field validation under cotton-based cropping systems and lack of comparative economic analysis. |
| M. M. Patel | 2024 | RBD with 6 integrated weed management treatments under irrigated cotton conditions with 4 replications. | Hand weeding and pendimethalin-based integrated treatments significantly enhanced growth, yield attributes, seed cotton yield, and reduced weed dry weight. | Study did not assess residual herbicide effects or sustainability of repeated herbicide applications. |

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| N. S. Rathod | 2024 | Split plot design involving 3 plant densities and 4 weed management practices during kharif 2021. | Pyrithiobac sodium + quizalofop ethyl followed by hand weeding recorded highest seed cotton yield, weed control efficiency, net returns, and B:C ratio. Higher plant density improved yield. | Interaction of weed management with nutrient management and long-term productivity was not studied. |
| K. R. Chavhan | 2023 | RBD with 8 treatments and 3 replications evaluating pre- and post-emergence herbicides in sesame. | Weed-free treatment recorded highest seed yield and returns; pendimethalin + hand weeding proved economically effective for weed management. | Study conducted on sesame, limiting direct applicability to cotton systems. |
| M.D. Yenpreddiwar | 2023 | Comparative evaluation of weed-free control, pendimethalin application, hoeing, and hand weeding practices. | Weed-free treatment produced maximum growth, boll yield, weed control, and economic returns. Pendimethalin + cultural practices ranked second. | Did not compare advanced herbicide combinations or integrated weed management systems extensively. |
| S. G. Mane | 2023 | Study on high-density planting and weed management practices evaluating AGR, CGR, RGR, and LAI in cotton. | Weed-free treatment and high-density planting improved AGR, dry matter accumulation, CGR, RGR, and LAI. | Economic feasibility and weed species dynamics under different densities were not evaluated. |
| Kamble Anand Shankar | 2022 | RBD with 3 replications conducted during 2017–18 and 2018–19 evaluating clomazone, pendimethalin, pyrithiobac sodium, and quizalofop ethyl combinations. | Clomazone 50 EC @ 250 g a.i./ha effectively controlled weeds, reduced nutrient losses, and increased seed cotton yield. Sequential herbicide application proved most effective. | Long-term herbicide residue effects and resistance management strategies were not discussed. |
| N. Varsha | 2019 | RBD with 3 replications assessing mechanical weeding, polymulch, and herbicide sequences in red and black soils. | Mechanical weeding and polymulch effectively reduced weed growth. Diuron followed by pyrithiobac sodium + quizalofop ethyl reduced weed density significantly. | Impact on cotton yield economics and soil biological health was not fully explored. |
| B. Madavi | 2017 | Factorial experiment involving 4 planting densities and 4 weed management practices during kharif 2015. | Plant density of 1,11,111 plants/ha and pendimethalin followed by pyrithiobac sodium + quizalofop-p-ethyl produced highest kapas yield and ginning percentage. | Study lacked assessment of sustainability, herbicide resistance, and environmental impacts of repeated herbicide use. |
| Meher Nirgundikar | 2024 | Field survey with vegetation sampling; ecological indices used (Shannon index, Simpson index) to assess diversity and dominance. | *Chromolaena odorata* and *Senna uniflora* were dominant invasive weeds. Shannon index ranged 2.10–3.16 and Simpson index 0.84–0.93, indicating moderate to high diversity with strong invasion impact on native flora. | Did not include crop-specific (cotton) phytosociological analysis or detailed parameters like frequency, density, abundance, and IVI; limited agroecosystem-based comparison. |
| Nagaraju Navagana | 2017 | Phytosociological survey using quadrat method; analysis of frequency, density, abundance, and IVI. | 55 weed species from 21 families recorded; Asteraceae was dominant family. *Phyllanthus debilis*, *Chromolaena odorata*, and *Chenopodium album* showed high IVI and dominance in cotton fields. | Lacked analysis of environmental/management factors influencing weed distribution and spatial variation; limited region-specific ecological interpretation. |

## 3. Research Gap

There is little information available about the phytosociological analysis of weed flora, particularly in the cotton fields of Shrirampur and Rahuri tehsils in Maharashtra, despite the fact that numerous studies on weed management in cotton agriculture have been carried out. While comprehensive studies on weed community structure, frequency, relative frequency, density, relative density, abundance, relative abundance, dominance, relative dominance, and Important Value Index (IVI) are relatively rare, prior research has mostly concentrated on chemical weed control and yield management. Furthermore, there is insufficient documentation of regional differences in weed composition brought on by shifting meteorological conditions, irrigation techniques, and agricultural activities. Additionally, there is not enough information to compare the ecological behavior and diversity of weeds in these two significant tehsils that cultivate cotton. By offering a methodical phytosociological evaluation of the weed flora in cotton fields, the current study seeks to close this gap and aid in the identification of dominant weed species and the development of location-specific weed management plans for sustainable cotton production.

## 4. Methodology

During the Kharif seasons, the current phytosociological study of weeds linked to cotton crops was conducted in the tehsils of Shrirampur and Rahuri. While phytosociological study employed the random quadrat sample approach from 2020 to 2022, weed collection took place between 2019 and 2025. Using random quadrat sampling procedures, the study sought to examine the distribution, composition, and ecological significance of weed flora found in cotton fields. Mandal-wise divisions were made in both tehsils, and villages of agricultural importance were chosen for further study. Five typical cotton fields were chosen at random for phytosociological observations from each revenue mandal. Ten 1 × 1 m iron rod quadrats were randomly placed in each chosen cotton field using the random quadrat sampling method to document the weed growth. Because herbaceous plant species made up the majority of the weed flora in cotton fields, the quadrat approach was used. During the survey and data gathering process, necessary field supplies like a GPS camera, rope, string, iron nails, notebook, field diary, scale, pencil, pen, eraser, and quadrat frames were utilized. To document the prevalence and abundance of weed species, thorough field visits were carried out at various phases of cotton crop growth. For every weed species found in the cotton fields, phytosociological metrics like frequency, relative frequency, density, relative density, abundance, relative abundance, dominance, relative dominance, and Important Value Index (IVI) were computed. In order to comprehend the homogeneity and heterogeneity of weed vegetation in the study region, frequency classes were established using Raunkiaer's frequency classification method.

### Data Collection

During the Kharif cropping seasons, comprehensive field studies were carried out in cotton-growing regions of Shrirampur and Rahuri tehsils. In every cotton field, quadrats chosen at random were used to record weed observations. The quantity and distribution of each type of weed were meticulously recorded in each quadrat. Several phytosociological characteristics were computed using the gathered data.

The percentage of quadrats in which a specific weed species was found out of all the quadrats examined was used to calculate frequency. To calculate relative frequency, divide each species' frequency by the total frequency of all species, then multiply the result by 100. Relative density was calculated by comparing the density of each species to the overall density of all species, whereas density was calculated as the total number of individuals of a species present per quadrat. Relative abundance was obtained by expressing each species' abundance as a percentage of total abundance. Abundance was computed by dividing the total number of individuals of a species by the number of quadrats in which the species appeared. To ascertain the dominance status of weed species in cotton fields, Dominance and Relative Dominance were computed using standard phytosociological techniques. Lastly, the Relative Frequency, Relative Density, and Relative Dominance numbers were added up to determine each weed species' Important Value Index (IVI). In order to analyze the ecological distribution pattern and vegetation structure of weeds connected to cotton crop ecosystems, the weed species were then categorized into Raunkiaer's frequency classes (A–E) according to their percentage frequency.

**Formulas used**

Absolute Frequency:

$No\ of\ quadats\ in\ which\ speceis\ occured\ /Total\ no\ of\ qudrats\ studiedX\ 100$ ……… [4.1]

Relative frequency (RF):

$Absolute\ value\ of\ a\ species/ sum\ of\ absolute\ frequency\ values\ of\ all\ the\ species\ x100$ ……………………………………………… [4.2]

Absolute Density:

$Total\ no\ of\ individuals\ of\ a\ species\ /total\ no\ of\ quadrats\ studied$ …………… [4.3]

Relative density:

$Absolute\ density\ of\ the\ species\ in\ question\ / sum\ of\ absolute\ densities\ of\ all\ the\ species\ x100$ ……………………………………………….. [4.4]

Abundance:

$Total\ no\ of\ individuals\ of\ a\ species\ in\ all\ the\ quadrats\ / total\ no\ of\ quadrats\ in\ which\ the\ spcies\ occured$ ……………………………………………….. [4.5]

Relative abundance:

$Total\ no\ of\ individuals\ of\ species\ A/ Total\ no\ of\ individuals\ of\ all\ the\ species\ recorded\ x100$ ……………………………………………….. [4.6]

Dominance:

$Absolute\ density\ of\ a\ species /number\ of\ quadrats\ in\ which\ the\ species\ occurred\ x100$ ……………………………………………… [4.7]

Relative dominance:

$Dominance\ of\ a\ species/sum\ of\ dominance\ of\ all\ the\ speciesx100$ ……………………………………………… [4.8]

Important Value Index (I.V.I.):

$Relative\ frequency + Relative\ density + Relative\ dominance$ ……………………………………………… [4.9]

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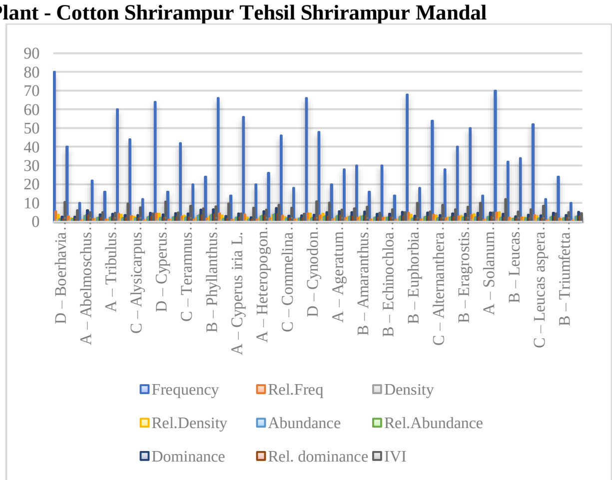
Table 2 Data Collection of cotton weeds in Rahiuri and Shrirampur regions

| | | | |
|---|---|---|---|
| *Abelmoschus ficulneus* | *Abutilon indicum* | *Acalypha indica* | *Acalypha malabarica* |
| *Acanthospermum hispidum* | *Achyranthes aspera* | *Acrachne racemosa* | *Ageratum conyzoides* |
| *Alternanthera sessilis* | *Alysicarpus bupleurifolius* | *Alysicarpus scariosus* | *Alysicarpus vaginalis* |
| *Amaranthus hybridus* | *Amaranthus polygonoides* | *Amaranthus spinosus* | *Amaranthus viridis* |
| *Ammannia baccifera* | *Bidens pilosa* | *Boerhavia diffusa* | *Boerhavia erecta* |
| *Calyptocarpus vialis* | *Cardiospermum halicacabum* | *Celosia argentea* | *Cenchrus ciliaris* |
| *Chloris barbata* | *Chloris virgata* | *Cleome viscosa* | *Clitoria ternatea* |
| *Commelina benghalensis* | *Commelina diffusa* | *Commelina forskaolii* | *Convolvulus arvensis* |
| *Corchorus olitorius* | *Corchorus trilocularis* | *Crotalaria hebecarpa* | *Crotalaria juncea* |
| *Cucumis maderaspatanus* | *Cucumis melo* | *Cyanthillium cinereum* | *Cyanotis axillaris* |
| *Cyanotis fasciculata* | *Cynodon dactylon* | *Cyperus compressus* | *Cyperus difformis* |
| *Cyperus esculentus* | *Cyperus iria* | *Cyperus pumilus* | *Cyperus rotundus* |
| *Dactyloctenium aegyptium* | *Datura innoxia* | *Desmodium dichotomum* | *Dichanthium annulatum* |
| *Dicliptera paniculata* | *Digera muricata* | *Digitaria bicornis* | *Digitaria ciliaris* |
| *Dinebra retroflexa* | *Echinochloa colona* | *Eclipta prostrata* | *Eleusine indica* |
| *Eragrostis ciliaris* | *Eragrostis minor* | *Eragrostis tenella* | *Eragrostis unioloides* |
| *Eragrostis viscosa* | *Euphorbia heterophylla* | *Euphorbia hirta* | *Euphorbia hypericifolia* |
| *Euphorbia parviflora* | *Euphorbia thymifolia* | *Evolvulus alsinoides* | *Gomphrena celosioides* |
| *Heteropogon contortus* | *Hibiscus panduriformis* | *Indigofera cordifolia* | *Indigofera hochstetteri* |
| *Ipomoea biflora* | *Ipomoea eriocarpa* | *Ipomoea triloba* | *Lagascea mollis* |
| *Lantana camara* | *Launaea procumbens* | *Leucas aspera* | *Leucas longifolia* |
| *Leucas martinicensis* | *Leucas urticifolia* | *Malvastrum coromandelianum* | *Martynia annua* |
| *Melanocenchris jacquemontii* | *Merremia emarginata* | *Moorochloa eruciformis* | *Oldenlandia corymbosa* |
| *Oldenlandia herbacea* | *Oxalis corniculata* | *Panicum repens* | *Parthenium hysterophorus* |
| *Paspalum distichum* | *Pavonia zeylonica* | *Phyllanthus amarus* | *Phyllanthus maderaspatensis* |
| *Physalis angulata* | *Polygala arvensis* | *Polygala erioptera* | *Portulaca oleracea* |
| *Portulaca quadrifida* | *Psoralea corylifolia* | *Rhynchosia minima* | *Ricinus communis* |
| *Senna tora* | *Setaria intermedia* | *Setaria verticillata* | *Sida acuta* |
| *Sida cordata* | *Sida spinosa* | *Solanum americanum* | *Solanum nigrum* |
| *Solanum villosum* | *Solanum virginianum* | *Sonchus asper* | *Spermacoce articularis* |
| *Tephrosia pumila* | *Teramnus mollis* | *Tetrapogon tenellus* | *Trianthema portulacastrum* |
| *Trichodesma indicum* | *Trichodesma zeylanicum* | *Tridax procumbens* | *Triumfetta rhomboidea* |
| *Triumfetta rotundifolia* | *Urochloa panicoides* | *Urochloa ramosa* | *Urochloa reptans* |
| *Vigna trilobata* | *Xanthium strumarium* | | |

## 5. Results and Discussion

The goal of the current study was to examine the weed flora connected to cotton crop fields in several mandals of the Ahmednagar district's Rahuri and Shrirampur tehsils. The survey found that the chosen mandals varied significantly in terms of weed frequency, abundance, and composition. The distribution and occurrence of several plant species found in the cotton fields of Shrirampur, Belapur, Taklibhan, Undirgaon, Rahuri, Satral, Taharabad, Deolali Pravara, Taklimiya, Brahamni, and Vambori mandals are depicted graphically. Overall, the study provides valuable baseline data for next weed management and ecological research while highlighting the richness and distribution pattern of weed flora in the cotton ecosystems of Shrirampur and Rahuri tehsils.

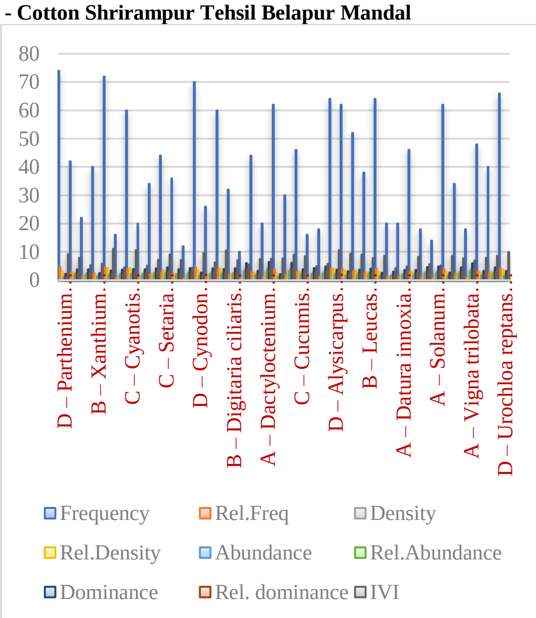
**Plant - Cotton Shrirampur Tehsil Shrirampur Mandal**




Graph 1 Plant - Cotton Shrirampur Tehsil Shrirampur Mandal

The phytosociological analysis of weed flora in A total of 1,439 individuals of various weed species were found in cotton fields, which were spread across 50 quadrats. The studied area was heavily infested with weeds, as evidenced by the overall density, abundance, and dominance values of 28.78, 90.63, and 181.26, respectively. Parthenium hysterophorus L. exhibited the highest IVI value (12.09), maximum frequency (70%), and density (1.44) among the species that were observed, demonstrating its invasive and dominant nature. In cotton fields, Cynodon dactylon (L.) Pers. (IVI 10.92), Cyperus rotundus L. (IVI 10.74), and Boerhavia erecta L. (IVI 10.55) were also quite prevalent weeds. Tetrapogon tenellus, Euphorbia hypericifolia, and Euphorbia heterophylla were among the species that demonstrated moderate to high ecological significance. Conversely, species with lower IVI levels, such as Sida spinosa, Pavonia zeylonica, and Abutilon indicum, showed restricted distribution.

**Plant - Cotton Shrirampur Tehsil Belapur Mandal**




Graph 2 Plant - Cotton Shrirampur Tehsil Belapur Mandal

The phytosociological research of weed flora in cotton fields found 1,419 individuals in 50 quadrats, with a total density of 28.38, abundance of 78.50,

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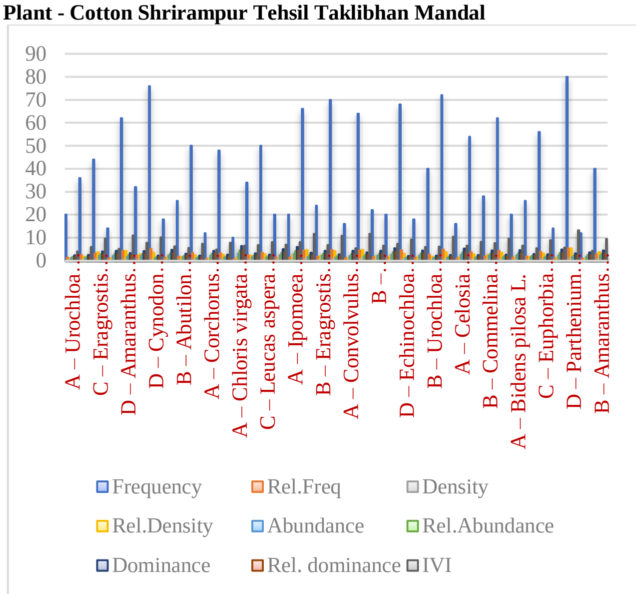
and dominance of 157.0. Among all species, Digera muricata (L.) Mart. had the highest IVI value (11.04) as well as a high frequency (72%) and density (1.22), indicating that it dominated the studied region. Cyanotis axillaris (L.) D.Don ex Sweet (IVI 10.59), Alysicarpus scariosus (IVI 10.58), and Setaria intermedia Roem. & Schult. (IVI 10.48) were also quite common weeds. Urochloa reptans (L.) Stapf, Cynodon dactylon (L.) Pers., Parthenium hysterophorus L., and Setaria verticillata (L.) P. Beauv. showed higher frequency and ecological value, showing strong adaptability in cotton fields. Commelina benghalensis, Cucumis maderaspatanus, and Phyllanthus maderaspatensis all had moderate IVI levels. In contrast, taxa such as Cyanotis fasciculata, Eleusine indica, and Lagascea mollis displayed lower IVI values, indicating limited occurrence and distribution.

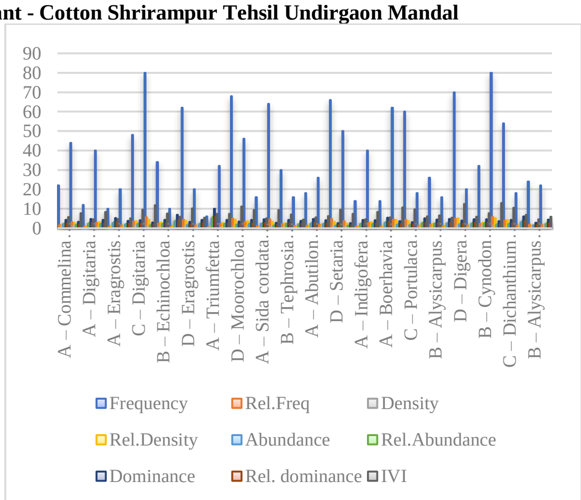
**Plant - Cotton Shrirampur Tehsil Taklibhan Mandal**




Graph 3 Plant - Cotton Shrirampur Tehsil Taklibhan Mandal

The phytosociological research of cotton field weeds found 1,189 individuals in 50 quadrats, with a total density of 23.78, abundance of 71.86, and dominance of 143.72. Parthenium hysterophorus L. had the highest IVI value (13.21) among the recorded weeds, as well as the highest frequency (80%) and density (1.30), demonstrating its dominant and invasive role in the cotton ecosystem. Other prevalent weeds included Acanthospermum hispidum DC. (IVI 11.72), Cyanotis axillaris (L.) D.Don ex Sweet (IVI 11.66), Amaranthus viridis L. (IVI 10.95), Boerhavia erecta L. (IVI 10.86), and Commelina forskaolii Vahl (IVI 10.46). Moorochloa eruciformis, Eragrostis tenella, Euphorbia heterophylla, and Amaranthus polygonoides all have moderate ecological value. Species including Urochloa reptans, Corchorus olitorius, and Acalypha malabarica have lower IVI values, indicating limited distribution and occurrence.

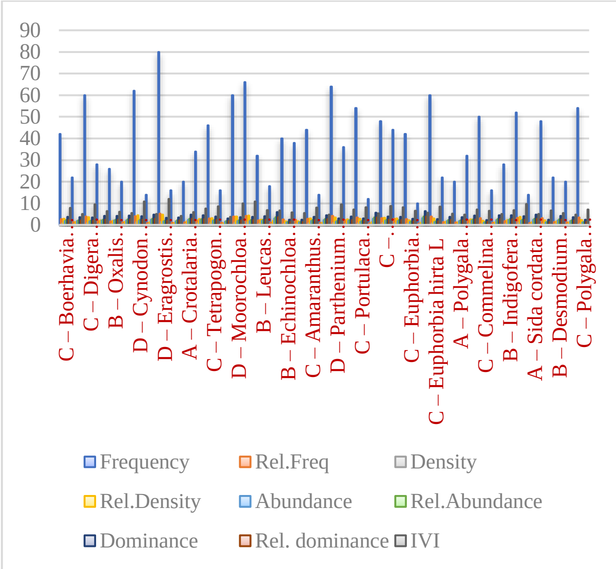
**Plant - Cotton Shrirampur Tehsil Undirgaon Mandal**




Graph 4 Plant - Cotton Shrirampur Tehsil Undirgaon Mandal

The phytosociological investigation of weed flora in cotton fields found 1,341 individuals in 50 quadrats, with a total density of 26.82, abundance of 85.49, and dominance of 170.98. Parthenium hysterophorus L. has the greatest IVI value (13.04), as well as the highest frequency (80%) and density (1.42), showing that it is extremely dominating and invasive. Digera muricata (L.) Mart. had a high ecological importance, with an IVI score of 12.42, followed by Cyperus rotundus L. (11.80), Moorochloa eruciformis (Sm.) Veldkamp (11.14), and Solanum villosum Mill. (10.69). Dichanthium annulatum, Eragrostis tenella, Portulaca oleracea, and Setaria verticillata exhibited moderate dominance, indicating widespread distribution in cotton fields. Digitaria ciliaris, Rhynchosia minima, and Alysicarpus vaginalis exhibited lower IVI values, indicating restricted occurrence and distribution.

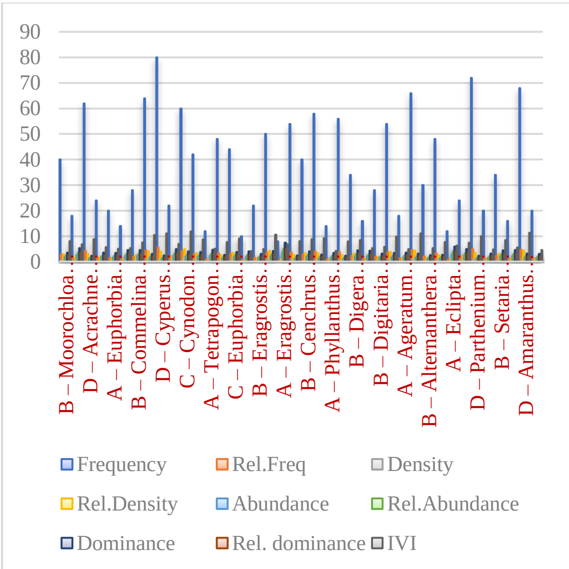
**Plant - Cotton Rahuri Tehesil Rahuri Mandal**




Graph 5 Plant - Cotton Rahuri Tehesil Rahuri Mandal

The phytosociological investigation of weed flora in cotton fields found 1,388 individuals in 50 quadrats, with a total density of 27.76, abundance of 82.94, and dominance of 165.88. Among the documented weeds, Eragrostis tenella (L.) P. Beauv. had the highest IVI value (12.02) and the highest frequency (80%), indicating that it was widely distributed in the research region. Other very dominating species included Cynodon dactylon (L.) Pers. and Urochloa reptans (L.) Stapf, both had IVI values of 10.89, followed by Moorochloa eruciformis (9.94), Digera muricata (9.60), Cyanotis axillaris (9.64), and Parthenium hysterophorus (9.52). Dactyloctenium aegyptium, Tetrapogon tenellus, Euphorbia hirta, and Portulaca quadrifida all have moderate ecological importance. Species including Abutilon indicum, Psoralea corylifolia, and Polygala erioptera have lower IVI values, indicating limited occurrence and distribution.

**Plant - Cotton Rahuri Tehesil Satral Mandal**




Graph 6 Plant - Cotton Rahuri Tehesil Satral Mandal

The phytosociological examination of weed flora in cotton fields identified 1,225 individuals from 50 quadrats with overall density (24.50), abundance

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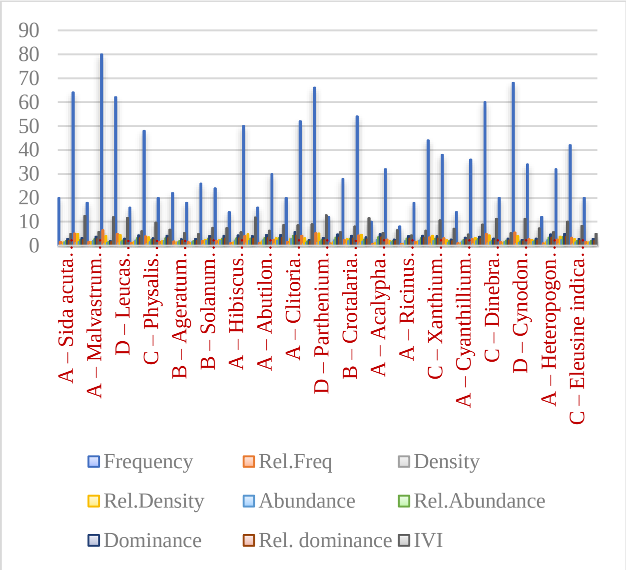
(74.83), and dominance (149.66), indicating a moderate to high weed invasion in the studied area. Cynodon dactylon (L.) Pers. had the highest IVI value of any recorded species (11.83), followed by Amaranthus hybridus L. (11.34), Cyperus rotundus L. (11.04), Acanthospermum hispidum DC. (11.02), and Moorochloa eruciformis (11.04), indicating their strong dominance and widespread distribution in cotton agroecosystems. Eragrostis tenella, Setaria intermedia, and Digera muricata displayed great ecological relevance, with IVI values above 10, demonstrating their adaptation and persistence in crop areas. Moderate IVI values were detected in species such as Echinochloa colona, Boerhavia erecta, Cyanotis axillaris, and Urochloa reptans, indicating their widespread distribution. In contrast, species including Celosia argentea, Phyllanthus amarus, and Xanthium strumarium displayed lower IVI values, indicating a limited distribution.

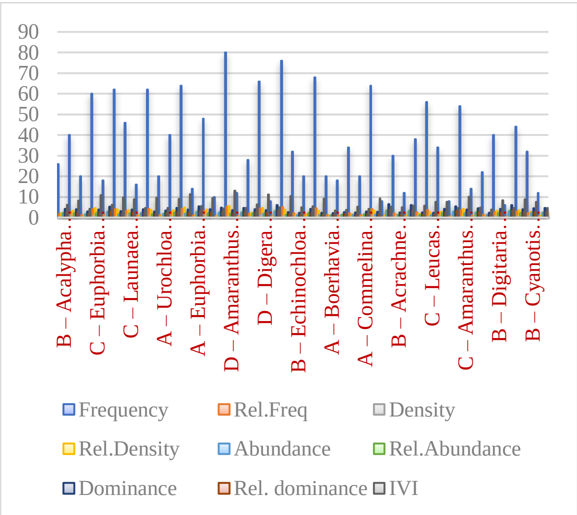
**Plant - Cotton Rahuri Tehesil Taharabad Mandal**




Graph 7 Plant - Cotton Rahuri Tehesil Taharabad Mandal

The phytosociological examination of weed flora in cotton fields found 1,047 individuals in 50 quadrats, with overall density (20.94), abundance (68.75), and dominance (137.49), indicating a moderate level of weed infestation in the studied area. Among all reported species, Parthenium hysterophorus L. had the highest IVI value (12.69), as well as the highest frequency (66%) and density (1.06), demonstrating its significant invasion and competitive character in cotton habitats. Other very dominating species were Boerhavia erecta L. (12.46), Rhynchosia minima (11.95), Amaranthus viridis L. (11.84), Cynodon dactylon (11.26), and Dinebra retroflexa (11.29), all of which demonstrate remarkable ecological flexibility and vast range.

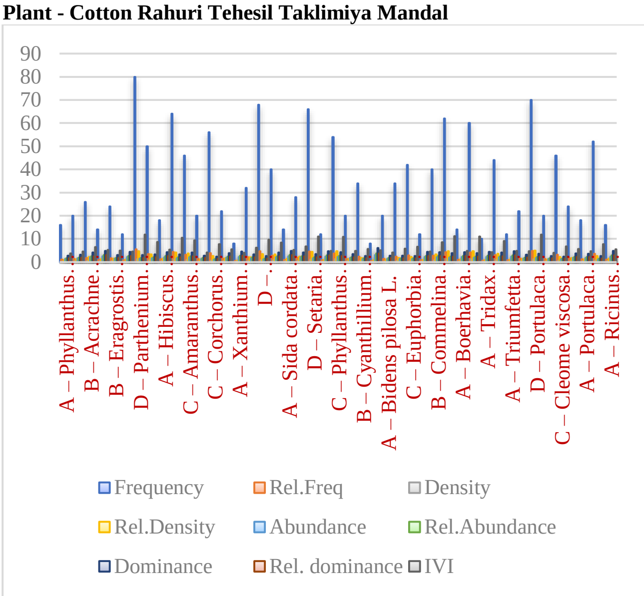
**Plant - Cotton Rahuri Tehesil Deolali Pravara Mandal**




Graph 8 Plant - Cotton Rahuri Tehesil Deolali Pravara Mandal

The flora was investigated using 50 quadrats in each dataset and revealed considerable species variety, with approximately 35-45 species reported and total individuals ranging from 1047 to 1419. The frequency estimates ranged greatly (between 20 and 80 percent), indicating that certain species were broadly spread while others were locally restricted. Across all datasets, the community was dominated by a few species with consistently high Importance Value Index (IVI), particularly Parthenium hysterophorus, Cynodon dactylon, Digera muricata, Cyperus rotundus, Amaranthus viridis/spinosus, Boerhavia erecta, and Echinochloa colona. Overall, the vegetation reflects a weed-dominated herbaceous community, with a small number of aggressive and fast-spreading species contributing much of the ecological dominance.

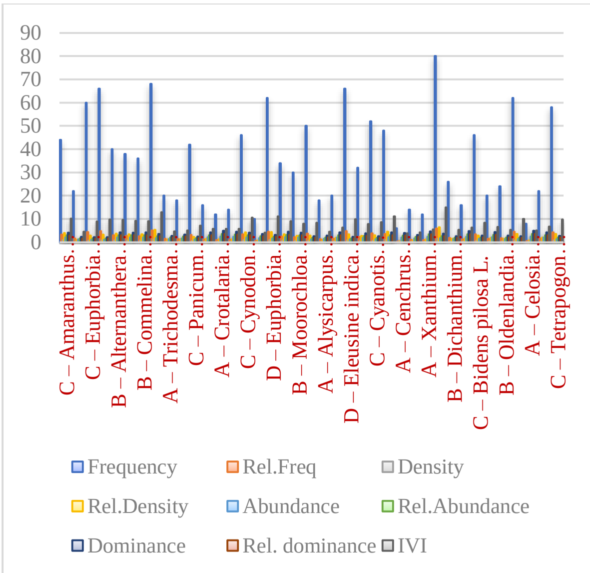
**Plant - Cotton Rahuri Tehesil Taklimiya Mandal**




Graph 9 Plant - Cotton Rahuri Tehesil Taklimiya Mandal

The phytosociological investigation, which used 50 quadrats, recorded 1261 individuals from 40 different plant types. The whole community had a total relative frequency of 25.22, a relative density of 82.27, and a relative abundance of 164.53, showing moderate to high species occurrence but unequal distribution across quadrats. The IVI values show that the vegetation is dominated by a few aggressive and well-adapted species. Parthenium hysterophorus (IVI 11.91), Portulaca oleracea (11.83), Cynodon dactylon (11.21), Dactyloctenium aegyptium (11.03), and Setaria verticillata (10.99) were the most common species in the community. Amaranthus hybridus (10.15), Acalypha indica (10.45), and Eragrostis ciliaris (9.05) demonstrated moderate dominance, although several species showed low IVI values, indicating sparse occurrence.

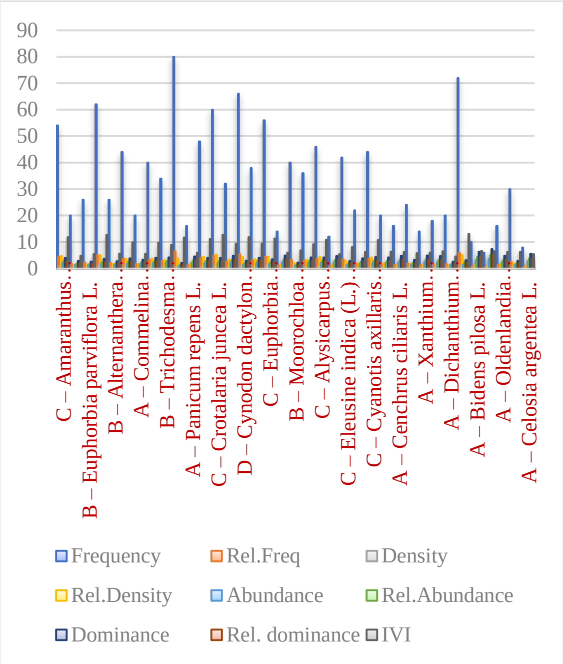
**Plant - Cotton Rahuri Tehesil Brahamni Mandal**




Graph 10 Plant - Cotton Rahuri Tehesil Brahamni Mandal

The vegetation analysis was conducted using 50 quadrats and yielded a total of 1132 individuals representing a broad assemblage of herbaceous plant species. The research region has moderate to high species richness, with many species dispersed unevenly across quadrats, indicating a diverse plant ecology. The total relative frequency (22.64), relative density (69.59), and relative abundance (139.19) indicate a community structure dominated by a few common species, with several others having lower representation. The vegetation was strongly influenced by high IVI species such as Eragrostis tenella (IVI 14.96), Euphorbia hirta (12.97), Parthenium hysterophorus (11.09), Euphorbia heterophylla (11.17), Cynodon dactylon (10.63), Launaea procumbens (10.09), and Digera muricata (11.21), which contributed most to the overall dominance and ecological importance of the community.

**Plant - Cotton Rahuri Tehesil Vambori Mandal**




Graph 11 Plant - Cotton Rahuri Tehesil Vambori Mandal

The investigation of 50 quadrats found a total of 1120 individuals, with cumulative values of relative frequency (22.4), relative density (73.29), and relative abundance (146.59), demonstrating unequal species distribution with clustering of individuals in specific locations. The vegetation is dominated by a few species with high IVI values, particularly Digitaria bicornis (12.97), Crotalaria juncea (12.82), Phyllanthus maderaspatensis (12.63), and Cynodon dactylon (11.76), which demonstrate considerable ecological dominance. Amaranthus hybridus (11.79) and Cyanotis axillaris (10.68) made large contributions, whereas numerous others had low IVI and a limited presence.

## 6. Conclusion

The current study on weed flora connected with cotton agriculture in the Shrirampur and Rahuri tehsils of Ahmednagar district revealed a diversified but weed-dominated plant community throughout all studied mandals. The study, which used 50 quadrats per site, found a total individual count ranging from 1,047 (Taharabad) to 1,439 (Shrirampur), demonstrating significant variance in weed abundance between locations. Intermediate values of 1,419 (Belapur), 1,388 (Rahuri), 1,341 (Undirgaon), 1,261 (Taklimiya), 1,225 (Satral), 1,189 (Taklibhan), 1,132 (Brahamni), and 1,120 (Vambori) demonstrate geographic variation in weed distribution.

The overall ecological metrics indicated moderate to high weed pressure, with density values ranging from 20.94 to 28.78, abundance from 68.75 to 90.63, and dominance from 137.49 to 181.26. This definitely suggests a severe infestation in the cotton agroecosystems of both tehsils. The fluctuation in these values indicates that changes in soil type, irrigation strategies, and crop management greatly altered weed population dynamics. Across all sites, the vegetation structure was heavily influenced by a few highly competitive and adaptive species. Parthenium hysterophorus was the most dominant invasive weed, with IVI values up to 13.21, followed by Cynodon dactylon (up to 11.83), Digera muricata (up to 12.42), Cyperus rotundus (up to 11.80), Amaranthus species (up to 11.8), Boerhavia erecta (up to 12.63), and Eragrostis tenella (up to 14.96). These species demonstrated high frequency (up to 80%), density (up to 1.46), and broad distribution across quadrats, showing significant ecological adaptability and competitive abilities.

Several species, including Abutilon indicum, Pavonia zeylonica, Sida spinosa, and seasonal grasses, have lower IVI values (<5-6), indicating a restricted distribution and decreased ecological relevance. The findings for relative frequency, density, and abundance revealed that weed communities were unevenly distributed, with a small number of species contributing disproportionately to the overall vegetation structure.

Overall, the study shows that cotton fields in Shrirampur and Rahuri tehsils are severely weed-infested, with high species diversity but strong dominance of a few invasive and fast-spreading weeds. The consistently high IVI values of important species across all mandals demonstrate their ecological success and competitive advantage over cotton crops. This scenario causes tremendous competition for nutrients, moisture, light, and space, which eventually affects crop productivity.

In conclusion, the phytosociological assessment provides critical baseline data on weed composition and dispersion in cotton ecosystems. The findings highlight the critical need for coordinated and site-specific weed management measures to control prevalent invasive species and promote sustainable cotton production in the region.

## 7. Future Scope

The current study gives a foundational understanding of weed composition and phytosociological organization in cotton fields in Shrirampur and Rahuri tehsils; nonetheless, there is ample room for future research. Future research can build on this study by conducting long-term monitoring throughout numerous cropping seasons to better understand seasonal and interannual differences in weed dynamics. Incorporating climate variables such as rainfall, temperature, and soil moisture may assist explain changes in weed abundance and dispersion patterns.

Further research might look into how diverse agronomic techniques including tillage systems, pesticide application, crop rotation, and organic farming affect weed variety and dominance. Advanced ecological methods including multivariate analysis, species distribution modeling, and remote sensing techniques can be used to map weed invasion on a broader scale. Additionally, molecular and physiological investigations of major weed species may shed light on their adaptation mechanisms, herbicide resistance, and competitive interactions with cotton crops. Future research should focus on developing predictive weed management models and eco-friendly control tactics to reduce weed pressure, improve crop productivity, and maintain sustainable cotton production in the study location.

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