Characterizing of Weed Population and Their Dominance Over the Existing *Rabi* Crops in West Bengal

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for the Partial Fulfillment of the Degree of
Master of Science (Agriculture in Agronomy)

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2023

Certificate

This is to certify that the project report entitled **Characterizing of Weed Population and Their Dominance Over the Existing *Rabi* Crops in West Bengal** submitted by **Subham Mahanty, Debranjan Maity, Tausif Jamal Roll No.** to the Midnapore City College, Midnapore, West Bengal, India during the year of 2023 in partial fulfillment for the award of the degree of M.Sc. in Agriculture in Agronomy is a bona fide record of project work carried out by him under my supervision. The contents of this report, in full or in parts, have not been submitted to any other Institution or University for the award of any degree.

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We do hereby declare that the present Master thesis entitled '**Characterizing of Weed Population and Their Dominance Over the Existing *Rabi* Crops in West Bengal**' embodies the original research work carried out by us in the Department of Agricultural Sciences, Midnapore City College, Paschim Medinipur, West Bengal, India under the supervision of Mr. Pratonu Bandyopadhyay, Assistant professor, Department of Agriculture, Midnapore City College, Kuturiya, Bhadutala, Paschim Medinipur, West Bengal, 721129. No part thereof has been submitted for any degree or diploma in any University.

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Dedicated to our Parents,
Friends, Family and Teachers

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Abstract

The *rabi* crops suffer badly due to weed infestation. The competitive nature of weeds towards resources like water, nutrient, sunlight, space etc. makes it detrimental for the crop plants in terms of growth, development and yield value. However, before estimating yield losses and revising the weed control strategies, identification and quantification of weeds are very important. A study on predominant weeds in five districts of southern West Bengal was carried out for characterizing weed population and enlisting their dominance over the existing *rabi* crops. In *rabi* season diversified cropping pattern is followed in different districts of West Bengal. The cereals, major pulses and oilseeds along with plenty of vegetables are cultivated in *rabi* season so the weed infestation leads to financial crisis of the farmers and major harm to the entire farming community. This study aims to evaluate the nature of the weed, weed intensity, their association with the crops, along with the identification, distribution and their composition in specific districts of West Bengal. The district-wise data sheets have been arranged through Ecological analysis of weed flora on the basis of Absolute frequency (AF), Relative frequency (RF), Absolute density (AD) and Relative density (RD). The ecological success of weed and their dominance over the crop was calculated through this survey work and that helped to know about the intensity of damage and to formulate an economic and effective strategy for the management of diversified weed flora in different districts of west Bengal.

***Keywords**:* - Predominant, Weed flora, *Rabi* season.

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Chapter 1: Introduction

1. Introduction

Weed is a wild plant growing where it is not desired. Weeds are integral part of crop ecosystem. Weeds can suppress crop growth and yield by effectively competing with crop for environmental resources like water, light, nutrients, space and production of allelopathic compounds (Ramireddy et al., 2020). Weeds cause an irreversible damage to plants due to their huge competitive ability and allelopathic interference with crops. Weed causes one third of the total losses caused by agricultural pest (DWR, 2015). The current total global grain production is ~2.1 billion metric tons. Assuming an overall yield loss of 10% due to weeds, the total loss in grain production is~200 million metric tons worldwide (FAO,2015). The estimation of yield loss in farmer's field due to weed is 12% for potato,10.5% in wheat,11% for mustard and 21% in kharif rice (Duary et al., 2015). As per the Directorate of Weed Science Research (DWSR), Indian Council of Agricultural Research, nearly one third of oilseed, half of the food grain and pulses produced are currently lost due to weeds. Additional production of 103 million tonnes of food grain,15 million tonnes of pulses,10 million tonnes of oilseed and 52 million tonnes of commercial crops per annum can be achieved through proper weed management technologies (Duary et al., 2013). The current global population of 7.7 billion is expected to reach over 9 billion by 2050. To feed this population, world food production will need to be increased by 70 to 100% (www.fao.org). The cultivated crops in West Bengal during *rabi* season are Ground nut, mustard, potato, green gram and *rabi* rice. According to the data collected from different agroecological regions over a period of 20 years it has been revealed that weed species about 60-70 in humid, per humid, sub humid, coastal and island ecosystems, 30-40 in semi-arid and 15-20 in arid ecosystem are found (Dixit et al., 2008). According to the Weed Atlas published by DWR, nearly 826 weed species were reported to cause yield losses in India out of which 80 species are reported as very serious and 198 were considered serious weeds (Choudhury & Singh, 2015). The important cropland weeds of *Rabi* season in West Bengal are *Cyperus difformis, Cyperus iria, Cyperus rotundus, Phyllanthus niruri, C. bonplandianum, Amaranthus viridis, Argemone Mexicana, Anagallis arvensis, D. sanguinalis, E. colona, Cynodon dactylon*, etc. (Duary et al., 2015). With nearly 72 percent of rural population agriculture is the predominant occupation in West Bengal, an agriculturally important province in eastern India. Because of the

diversity in soil, climate, and physiographic condition of West 2 Bengal along with climate change and variability have also played an important role in establishing and redistribution of weeds in crop field. Many invasive species also entered in India through food grain import (Duary & Mukherjee, 2013). Spectrum of weed flora is dynamic across habitats. Studies on flora and vegetation characteristics serve great importance to know the dynamics and relative importance of a species in a particular crop ecology. The nature of the weed, weed intensity, association with crop and other biotic characteristics, identification, distribution along with their composition in a specific region, are necessary to know about the intensity of damage and to formulate an economic and effective weed management strategy. Though there is diversity in crops and weed flora in West Bengal, detailed studies on weed distribution and weed dominance in crop field at *Rabi* season hasn't been carried out. With this perspective, an attempt was made to study about the weed distribution and weed dominance at several districts of West Bengal in *Rabi* season.

Chapter 2: Literature Review

2. Literature Review

2.1 Effect of different weed flora in potato field: -

According to Soren et al., 2018, a field experiment was conducted during the *rabi* season of 2015-2016 and 2016-2017 at Regional Research Sub-station, Raghunathpur, Bidhan Chandra Krishi Viswavidyalaya, Purulia, West Bengal. A broad spectrum of grasses and broad-leaved weeds infested potato fields. *Echinochloa colona, Digitaria sanguinalis, Eleusine indica, Cyperus rotundus, Chenopodium album, Anagallis arvensis, Trianthema monogyna, Fumaria parviflora, Digera arvensis, Alternanthera philoxeroides* are the important weed flora observed in the experimental potato plot. They found that There are various factors that affect the potato tuber yield. One of the majors constrain in this area is weed; which decreased 30-50% in tuber yield due to interference with potato under different agroecological situation. Uncontrolled weed growth reduces the tuber yield to 18-82% depending on types of weed flora, their intensity and duration of crop-weed competition. These weeds can cause yield reduction if not controlled properly.

2.2 Effect of different weed flora in rice field: -

As per the report of Mallick & Raha., 2015, from a case study on major weeds of Rice fields in district Bankura, West Bengal, where both the upland and lowland methods of paddy cultivation are practiced, but the per hector yield of paddy in this district is little less as compared to other parts of India due to many factors out of which the problem of weeds is of great concern. The persistent weed species give a severe competition to paddy crop and reduce the agricultural output. The weeds like *Echinochloa colona* and *Echinochloa crus-galli* shows maximum infestation in lowland system and it is difficult to identify these weeds at early stage (Before flowering) because of their resemblance with crop plants. In upland system the members of family Cyperaceae i.e., *Cyperus rotundus, C. iria* and *C. difformis* etc. were dominant. The weeds like *Boerhaavia diffusa, Oxalis corniculata, Paspalidium flavidum, Physalis minima, Malvastrum coromandelianum* etc. were reported particularly from upland sites while the weeds like *Marsilea quadrifolia, Echinochloa crusgalli, Scripus setaceus, Lippia nodiflora* were reported only from lowland sites. During the study period the authors have reported a total of 48 weeds belonging to 18 angiospermic and 1 pteridophytic families. Out of 18 angiospermic families the monocot families Cyperaceae and Poaceae having 11 and 10 weed species showed predominance,

respectively followed by dicot families Amaranthaceae and Asteraceae each containing 5 and 03 weeds, respectively. The family Euphorbiaceae contained 4 weeds while Commelinaceae was represented by 1 weed. The family Scrophulariaceae, contained 2 weed species. The 4 remaining families i.e., Polygonaceae, Convolvulaceae, Cuscutaceae, Malvaceae, Molluginaceae, Nyctaginaceae, Oxalidaceae, Portulacaceae, Rubiaceae, Solanaceae and Verbenaceae contained 1 weed species. The pteridophytic family i.e., Marsileaceae was represented by 1 weed species. Singh et al., 2005 reported that the weeds are a major impediment to rice production through their ability to compete for resources and their impact on product quality. Out of losses due to various biotic stresses, weeds are known to account for nearly one third. Uncontrolled weeds reduced the grain yield by 62.6% under transplanted rice.

2.3 Effect of different weed flora in groundnut field: -

According to Rao, 2000, the critical period of crop weed competition for groundnut to be up to 45 DAS. Hence for achieving maximum yield, timely and effective weed management during the critical period of weed competition is essential. Agostinho et al., 2006, reported that the weed interference resulted in maximum yield losses between 74 and 92 per cent in ground nut. As per the report of Shah & Pramanik, 2020, Weed infestation in first 30-40 days of crop-weed competition in *rabi* groundnut is critical due to the initial slow growth habit of the crop and low temperature during the month of January. Shah & Pramanik, 2020, also reported that the experimental groundnut field was infested with three categories of weeds under nine families. The total no of species was 11 out of which there were monocots like, *Echinochloa colona, Digitaria sanguinalis, Eleusine indica* and *Dactyloctenium aegyptium*. Broad leaves weeds like *Trianthem aportulacastrum*, *Gnaphalium polycephalum*, *Phyllanthus niruri*, *Spilanthe scalva*, *Digera arvensis* and *Chenopodium album*. *Cyperus rotundus* was present as a major weed in groundnut field. *Gnaphalium polycephalum, Spilanthes calva* among broadleaved, *Digitaria sanguinalis* among the grasses and *Cyperus rotundus* among the sedges were predominant throughout the cropping period.

2.4 Effect of different weed flora in wheat field: -

Karim & Mamun, 1988, reported that the wheat crop under competition produced reduced leaf, and flag leaf which ultimately caused less photosynthesis and supplied less assimilates

than required for production of normal spike. The number of spikelets per spike was higher in crop grown under weed free condition than in crop grown under competition with weeds. Hossain et al., 2010, conducted a field experiment at Wheat Research Centre, Dinajpur, Bangladesh during *rabi* season of 2008- 09 and observed that the Spike length was reduced in all wheat cultivars due to competition with weeds. The average reduction in spike length was 5.94%. The lowest spike length reduction was found in Shatabdi followed by Gourab, Sourav, BAW 1064 and Prodip, while the highest reduction was recorded in Sufi followed by BAW 1059 and Bijoy 5. Hansda et al., 2013, carried out a field experiment during *rabi* seasons of 2010-11 and 2011-12 in the instructional farm of Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, and found that the wheat field was dominated with highly aggressive broadleaved weeds like *Polygonum persicaria, Polygonum pensylvenicum, Physalis minima, Chenopodium album, Ageratum conyzoides, Oldenlandia diffusa*. Grasses like *Cynodon dactylon, Digitaria sanguinalis* were also observed in the experimental field at the initial stages. The dominant weed flora in the experimental field was two species of Polygonum having higher competitive ability and damaging potential than other broadleaved weeds.

2.5 Effect of different weed flora in pea flora: -

Tewari et al., 1997; Banga et al.; 1998 and Harker, 2001, reported weeds as a major problem for pea production. Weeds cause reduction in pea yield from 37.3 to 64.4 per cent. Avoiding early season weed interference is critical as Peas are poor competitors, particularly at the seedling stage. According to Kumar et al., 2009, The critical period for crop weed competition in pea is up to 60 days after sowing. As per the report of Das, 2016, weeds can hamper pea production in many ways. First, weeds can reduce yield through competition for resources like, light, moisture, nutrients, and space. Second, weeds may provide shelter for insect pests and pathogens that can affect crop production. Finally, late season weeds can be an infliction that reduces harvest efficiency. Das, 2016, conducted a field experiment at Pulses and Oilseeds Research Station, Berhampore, Murshidabad, West Bengal and reported that The experimental pea field was dominated by natural infestation of broad leaf weed (BLW) like *Anagalis arvensis, Chenopodiuln album*, *Convolvulus arvensis*, *Fumaria parviflora, Melilotus alba*, *Lathyrus aphaca, Euphorbia hirta, Parthenium hysterophorus, Gnaphalium leuteoalbum, Commelina banghalensis* and grasses like *Echinochloa colona, Cynodon dactylon, Digitaria sanguinalis* and sedges like *Cyperus rotundus*.

2.6 Effect of different weed flora in lentil field: -

Teja et al., 2017, conducted a field experiment during *rabi* season of 2014-2015 and 2015-2016 at farmer's field in Birbhum, West Bengal, and reported that the lentil field was infested with grasses, *Digitaria sanguinalis* and *Cynodon dactylon* and broadleaf weeds, *Croton bonplandianum* and *Gnaphalium indicum*. These weeds were predominant throughout the cropping period during both years of study. However, no sedge was noticed in the field.

2.7 Effect of different weed flora in mustard field: -

Teja & Duary, 2018, conducted a field experiment was conducted at Visva-Bharati, Sriniketan, West Bengal to study the effect of tillage and weed management practices on weed growth and productivity of yellow mustard in direct-seeded rice - yellow mustard – green gram cropping system. They reported that the total number of weed species was 16 out of which *Echinochloa colona, Digitaria sanguinalis, Cynodon dactylon* and *Cyanotis axillaris* among monocots and *Ageratum conyzoides, Spilanthes paniculata, Polygonum plebeium, Gnapahalium purpureum, Chenopodium album, Physalis minima, Eclipta alba, Oldenlandia corymbosa, Cleome viscosa, Ludwigia parviflora, Solanum nigrum* and *Indigofera hirsuta* among dicots made the composition of weed flora in yellow mustard field.

The detailed studies on taxonomic classification, distribution, and dominance of weed flora of West Bengal in *Rabi* season hasn't been done yet. This leads to problems regarding weed identification, calculating weed dominance over specific crops of specific districts and ideal weed management strategies. To identify and enlist the weed flora, to determine the dominance of weed flora over the existing crops of *rabi* season, to estimate the ecologically and economically effective weed management strategies and to suggest a better cropping pattern for the specific region of the different districts in west Bengal.

Chapter 3: Aims and Objective

3. Aims and Objective

The aim of our survey work is to study and collect the information about the characteristics, dominance and distribution pattern of weeds throughout several districts of West Bengal. The objectives of our study are -

1. To identify and enlist the weed flora of different districts in West Bengal.
2. To determine the dominance of weed flora over the existing crops of *rabi* season.
3. To estimate the ecologically and economically effective weed management strategies.
4. To suggest a better cropping pattern for the specific region of the different districts in west Bengal.

Chapter 4: Materials and Methods

4. Materials and Methods

Study Area:

Weed survey was conducted during *rabi* season of 2022-2023 in five selected districts from southern part of West Bengal. The districts were Jhargram (lies between 21°52'N to 22°48'N latitudes and 86°34'E and 87°20'E longitude), Paschim Medinipur (21°46´N to 22°57´N latitudes and 86°33̓É to 87°44̓É longitude), South 24 Parganas (22.1367°N, 88.5565°E), Purba Medinipur (21.9373°N, 87.7763°E), Birbhum (23°32′N to 24°35′N latitude and 88°1′E to 87°5′E longitude. (Fig.1)

Methods:

The weed survey was conducted during the *rabi* season of 2022-2023 in the different districts of west Bengal. To record the observation on the composition of weed flora, a stop was made after every 10 to 12 kilometers on the selected route of specific district. Frequent field trips were made in each side for collection of weed species, during this survey interviews were conducted from farmers and agriculturists of each site. The site for recording observation was selected about 200 meters away from the main road in case of cropped area so that it represents an undisturbed situation with natural weed flora mainly in different latitude and longitude. Difficult to-identify weeds associated with the *Rabi* season crops can be identified after blooming. However, familiar or known weeds can be identified even prior to flowering. The size of the quadrat has to be 1m x 1 m. Five spots will be considered in each village for a particular habitat. Species wise weed count will be made using the list count quadrat method suggested by Mishra (1968). After recording the data, daily data sheet has been arranged. Hence, district-wise average data sheet was prepared.

Personal Information of The Farmers: -

Sl. No.	Name of the Farmer	No. of Family Members	Gender		Address	Educational Qualificationof the Farmer
			Male	Female		
1.						
2.						
3.						
4.						

Sl. No.	Own land	Lease land	Total area of the land	Type of soil	Crops grown					
					Kharif		*Rabi*		Zaid	
					Crop	Area	Crop	Area	Crop	Area
1.										
2.										
3.										
4.										
5.										

Information about the collected weed: -

Sl. No.	Grass		Broad leaf		Sedge		Total No. of Weed
	Name	Number	Name	Number	Name	Number	
1.							
2.							
3.							
4.							
5.							

Ecological analysis of weed flora was done on the basis of Absolute Density (AD), Absolute Frequency (AF), Relative Frequency (RF), Relative Density (RD). Those parameters were calculated to express the ecological success of weed and their dominance over the crop.

Those below mentioned formula for calculating the following parameter was taken from Jibat et al., 2019.

$$\text{Absolute frequency (AF)} = \frac{\text{Number of quadrats of occurrence of a species}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of weed species}}{\text{Sum of frequency of all weed species}} \times 100$$

$$\text{Absolute density} = \frac{\textit{Total number of weeds in all quadrats}}{\textit{Total number of quadrats studied}}$$

$$\text{Relative density (RD)} = \frac{\text{Number of individuals of given species}}{\text{Sum of all individuals of all species}} \times 100$$

Materials: - For collection of weed species in the selected study area mainly two materials were needed. The quadrat (Fig.2) was used to select a specific spot in the field and to count the number of species while the paper envelop (Fig.3) was used to collect and store the weed sample for further analysis.

Fig.2: - Quadrat ($1m^2$)

Fig.3: - Paper envelope

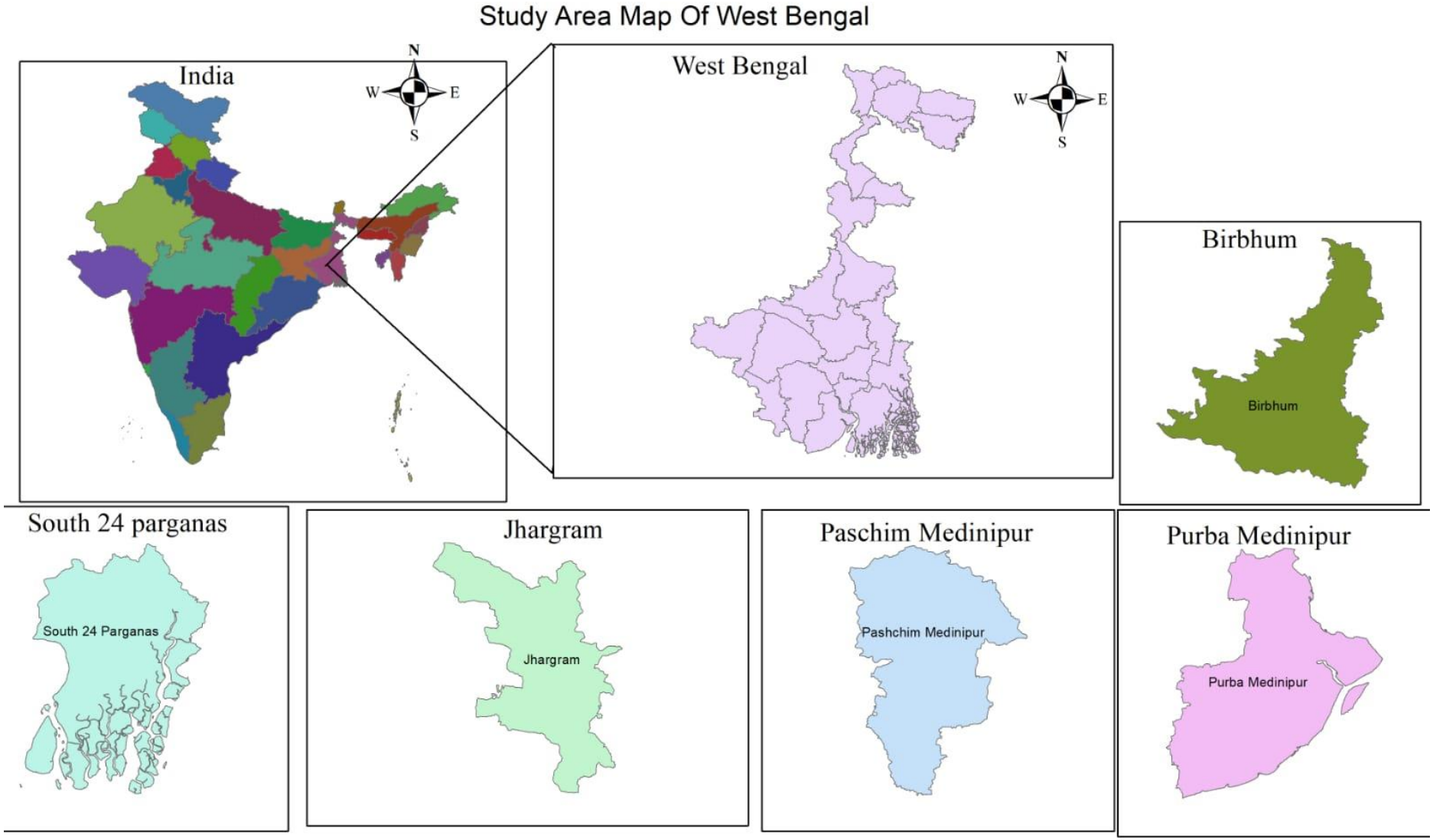


Fig.1: - Study Area of the survey work in West Bengal

Chapter 5: Results

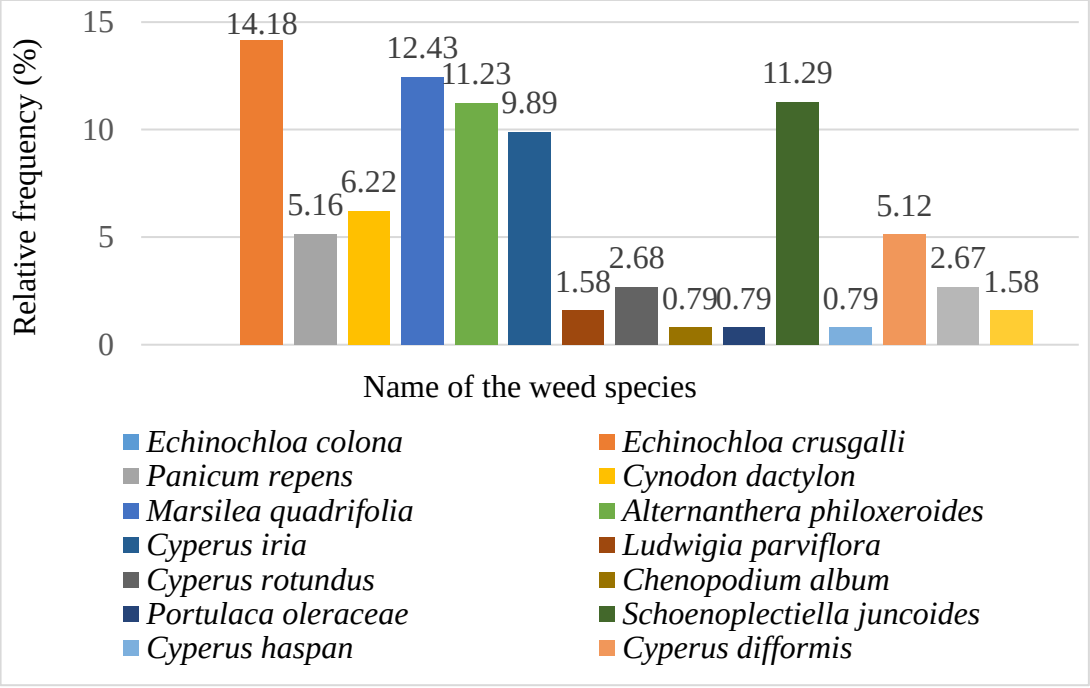
5. Results

The study was made in different districts on different weed floras. The result is presented as per specific crop of a particular district. Below, the result is discussed with data collected and analyzed with the help of table and graph.

5.1 Jhargram District: - Weed species were collected from rice, potato and mustard field from different blocks of Jhargram district.

5.1.1 Rice: - A total number of 16 weed species were identified from different rice field of Jhargram district. The most common families found in different rice field were Poaceae, Cyperaceae, Amaranthaceae, Araceae, Marsileaceae etc. The result showed that the Absolute density of weed flora in rice field of Jhargram district was 15.71, while the relative frequency and relative density of individual weed species ranges from 0.79% to 14.18% and 0.46% to 20.14% respectively. (Table 1)

The most occurred weed species in every quadrat was *Echinochloa crusgalli* (14.18%) followed by *Echinochloa colona* (13.53%) whereas the least occurred weed species with the lowest relative frequency of 0.79% were *Chenopodium album, Portulaca oleraceae* and *Cyperus haspan.* (Fig.4)

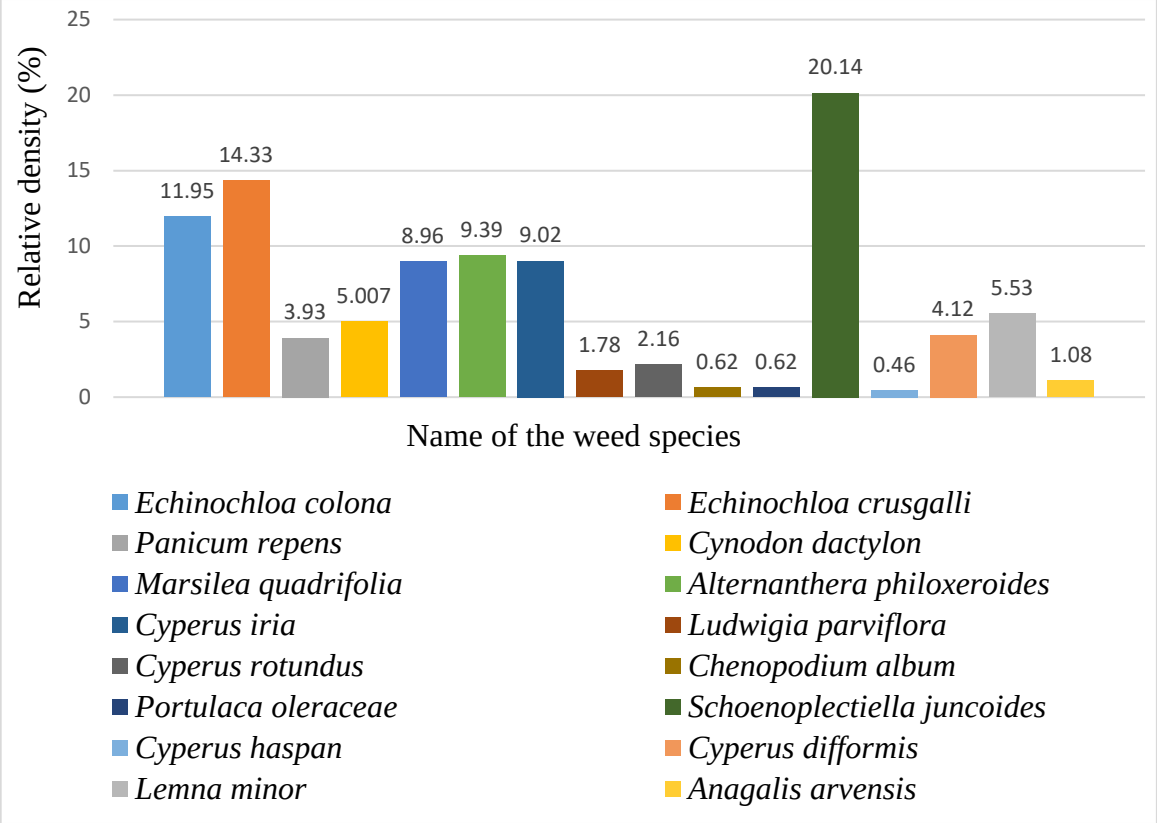


(**Fig.4: -** Relative frequency of weed species in rice field from Jhargram district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density
Rice	Jhargram	15.71	*Echinochloa colona*	Poaceae	71.43	13.53	11.95
			Echinochloa crusgalli	Poaceae	76.19	14.18	14.33
			Panicum repens	Poaceae	28.57	5.16	3.93
			Cynodon dactylon	Poaceae	33.33	6.22	5.007
			Marsilea quadrifolia	Marsileaceae	66.67	12.43	8.96
			Alternanthera philoxeroides	Amaranthaceae	61.90	11.23	9.39
			Cyperus iria	Cyperaceae	52.38	9.89	9.02
			Ludwigia parviflora	Onagraceae	9.52	1.58	1.78
			Cyperus rotundus	Cyperaceae	14.28	2.68	2.16
			Chenopodium album	Amaranthaceae	4.76	0.79	0.62
			Portulaca oleraceae	Portulacaceae	4.76	0.79	0.62
			Schoenoplectiella juncoides	Cyperaceae	61.90	11.29	20.14
			Cyperus haspan	Cyperaceae	4.76	0.79	0.46
			Cyperus difformis	Cyperaceae	28.56	5.12	4.12
			Lemna minor	Araceae	14.28	2.67	5.53
			Anagalis arvensis	Primulaceae	9.52	1.58	1.08

(Table1: **-** List of weeds of different rice field in Jhargram district**.)**

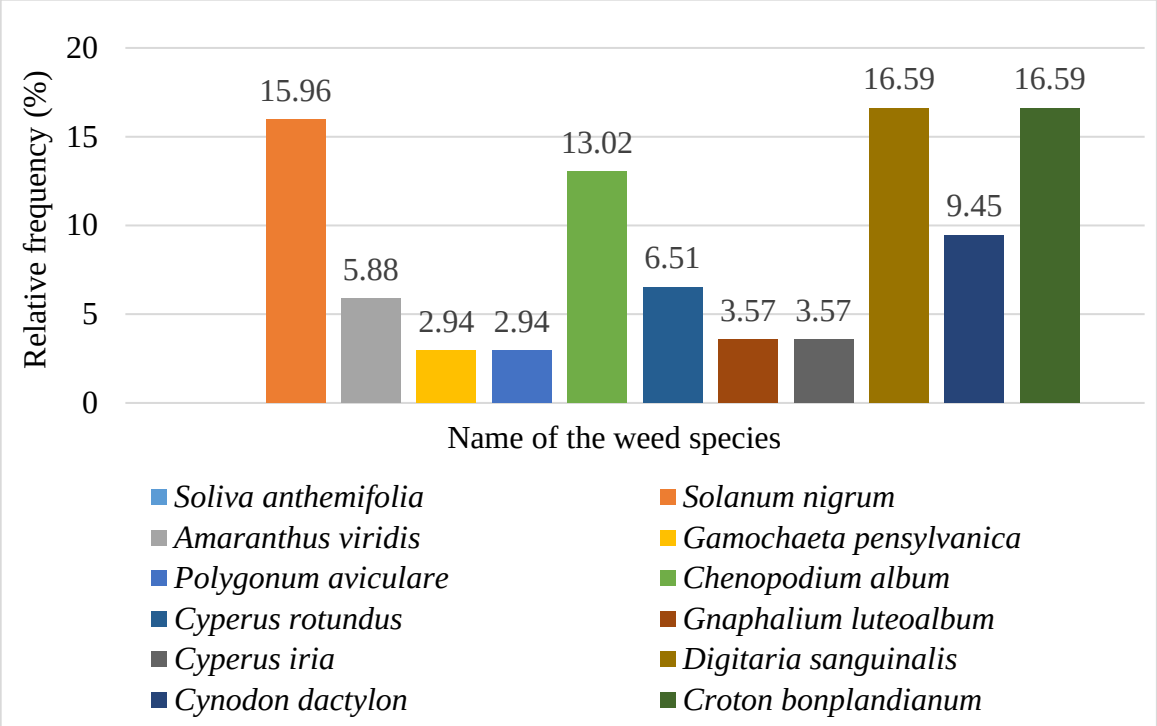
The most relatively dominant weed species was *Schoenoplectiella juncoides* (20.14%) followed by *Echinochloa crusgalli* (14.33%), while the least relatively dominant weed species with the relative density of 0.46% is *Cyperus haspan* (Fig.5).



(**Fig. 5: -** Relative density of weed species in rice field from Jhargram district.)

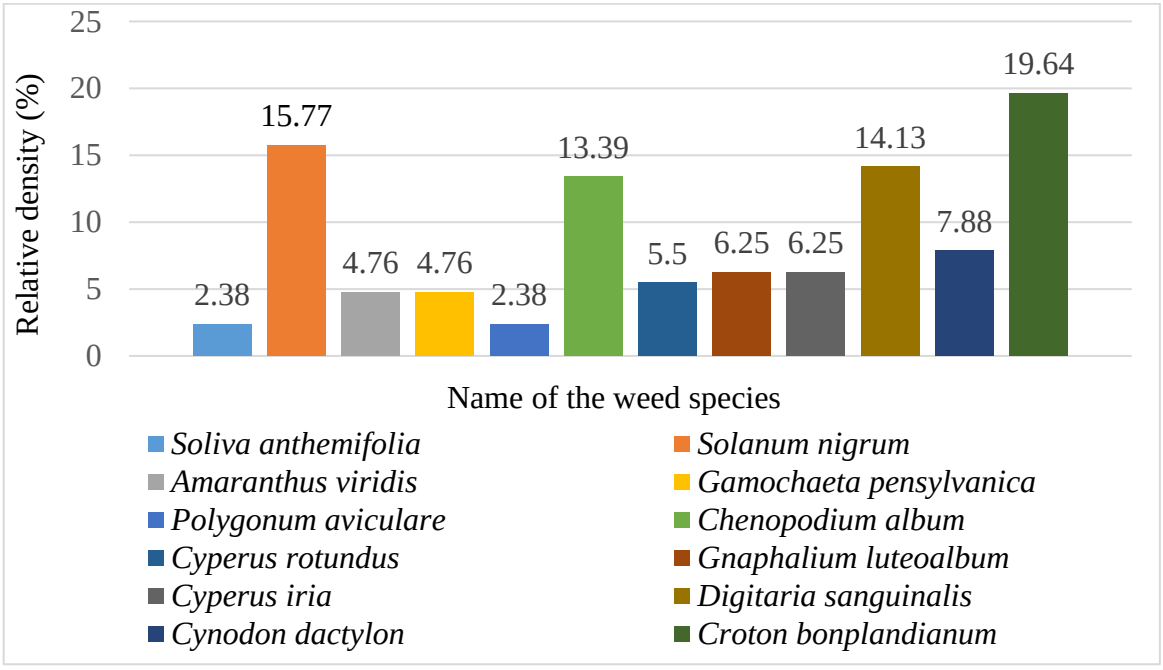
5.1.2 Potato: - A total number of 12 weed species were collected and identified from different Potato fields of Jhargram district. The most common families according to the number of listed species were Asteraceae, Amaranthaceae, Solanaceae, Poaceae etc. The calculated result showed that the Absolute density of weed flora in potato field of Jhargram district was 12.33, whereas the Relative frequency and Relative density of individual weed species ranges from 2.94% to 16.59% and 2.38% to 19.64% respectively. (Table 2)

The most relatively frequent weed species present in every quadrat was *Digitaria sanguinalis* (16.59%) & *Croton bonplandianum* (16.59%) followed by *Solanum nigrum* (15.96%), whereas the least relatively frequent weed species recorded with 2.94% relative frequency was *Gamochaeta pensylvanica* and *Polygonum aviculare*. (Fig. 6)



(**Fig. 6: -** Relative frequency of weed species in potato field from Jhargram district.)

The most relatively dominant weed species was *Croton bonplandianum* (19.64%) followed by *Solanum nigrum* (15.77%) and the relatively least dominant weed species recorded with least relative density of 2.38% was *Soliva anthemifolia* and *Polygonum aviculare* (Fig. 7).



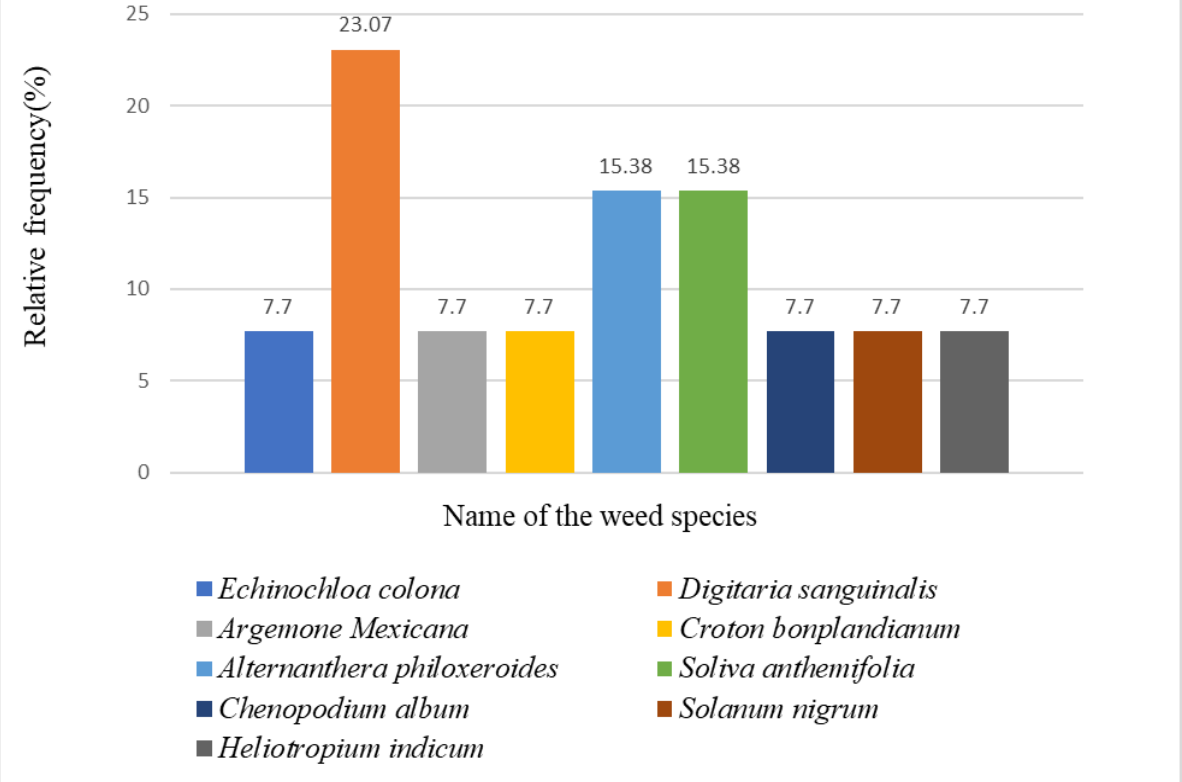
(**Fig.7: -** Relative density of weed species in potato field from Jhargram district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Potato	Jhargram	12.33	*Soliva anthemifolia*	Asteraceae	16.66	2.94	2.38
			Solanum nigrum	Solanaceae	83.33	15.96	15.77
			Amaranthus viridis	Amaranthaceae	33.33	5.88	4.76
			Gamochaeta pensylvanica	Asteraceae	33.33	2.94	4.76
			Polygonum aviculare	Polygonaceae	16.66	2.94	2.38
			Chenopodium album	Amaranthaceae	66.67	13.02	13.39
			Cyperus rotundus	Cyperaceae	33.33	6.51	5.50
			Gnaphalium luteoalbum	Asteraceae	16.66	3.57	6.25
			Cyperus iria	Cyperaceae	16.66	3.57	6.25
			Digitaria sanguinalis	Poaceae	83.33	16.59	14.13
			Cynodon dactylon	Poaceae	50	9.45	7.88
			Croton bonplandianum	Euphorbiaceae	83.33	16.59	19.64

(**Table 2: -** List of weeds of different potato field in Jhargram district.)

5.1.3 Mustard: - A total number of 9 weed species were identified and collected during the survey in different mustard fields from different blocks of Jhargram district. The families of the listed weed species were Poaceae, Amaranthaceae, Boraginaceae, Euphorbiaceae etc. The result showed that the absolute density of weed flora in mustard field of Jhargram district was recorded 11.34 m^{-2}, while the relative frequency and relative density of particular weed species ranged from 7.7% to 23.07%, and 5.88% to 23.52% respectively (Table no. 3).

The most relatively frequent weed was *Digitaria sanguinalis* (23.07%), followed by *Alternanthera philoxeroides* (15.38%) and *Soliva anthemifolia* (15.38%) and the minimum relative frequency of 7.7% was recorded by *Echinochloa colona*, *Argemone Mexicana*, *Croton bonplandianum*, *Chenopodium album*, *Solanum nigrum* and *Heliotropium indicum* (Fig. 8).

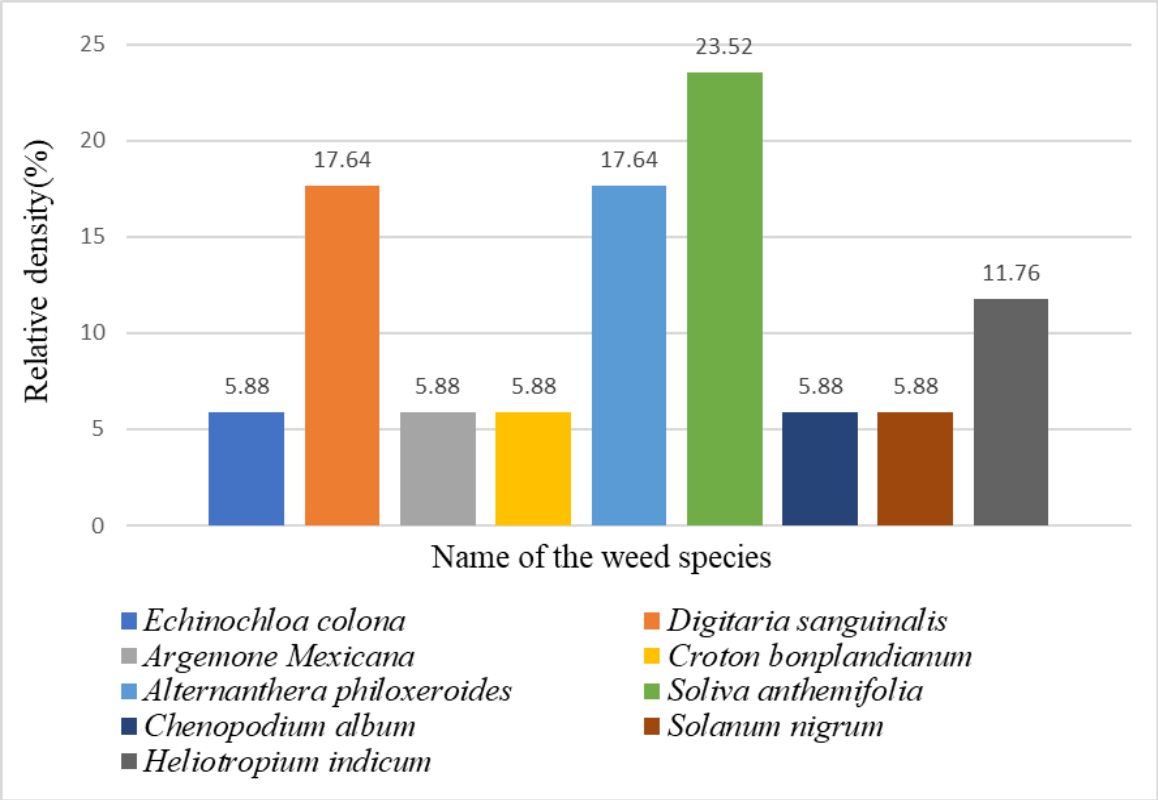


(**Fig.8: -** Relative frequency of weed species in mustard field from Jhargram district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Mustard	Jhargram	11.34	*Echinochloa colona*	Poaceae	33.33	7.7	5.88
			Digitaria sanguinalis	Poaceae	100	23.07	17.64
			Argemone Mexicana	Papaveraceae	33.33	7.7	5.88
			Croton bonplandianum	Euphorbiaceae	33.33	7.7	5.88
			Alternanthera philoxeroides	Amaranthaceae	66.67	15.38	17.64
			Soliva anthemifolia	Asteraceae	66.67	15.38	23.52
			Chenopodium album	Amaranthaceae	33.33	7.7	5.88
			Solanum nigrum	Solanaceae	33.33	7.7	5.88
			Heliotropium indicum	Boraginaceae	33.33	7.7	11.76

(**Table 3: -** List of weeds of different mustard field in Jhargram district.)

The most relatively dominant weed species was *Soliva anthemifolia* (23.52%) followed by *Alternanthera philoxeroides* (17.64%) and *Digitaria sanguinalis* (17.64%) while the least relatively dominant weed species recorded with the relative density of 5.88% were *Echinochloa colona, Argemone Mexicana, Croton bonplandianum, Chenopodium album* and *Solanum nigrum* (Fig. 9).

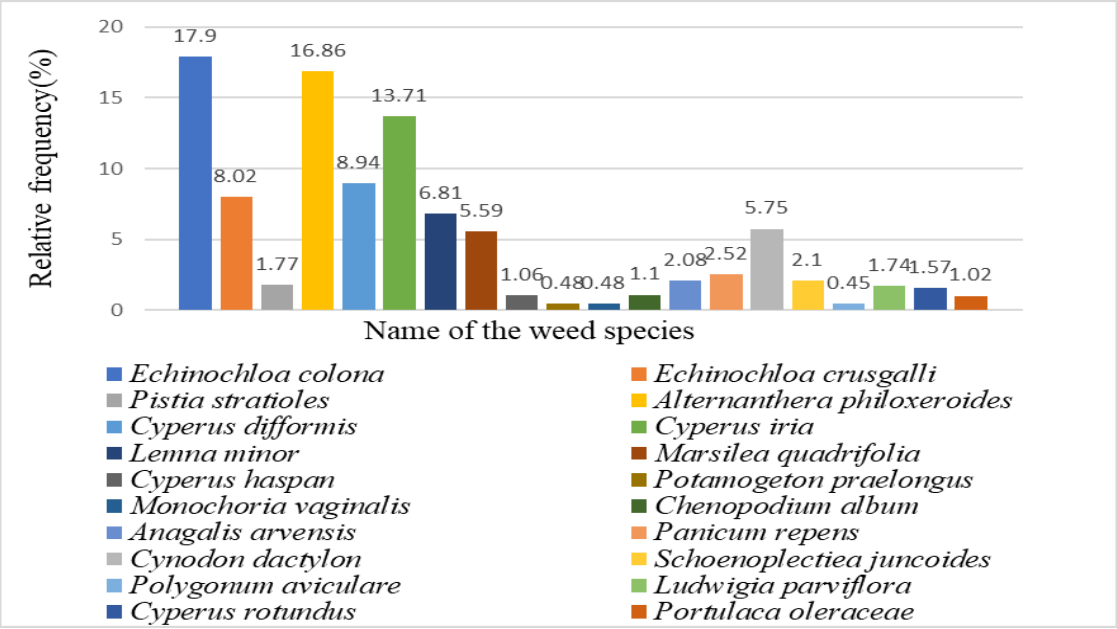


(**Fig.9: -** Relative density of weed species in mustard field from Jhargram district.)

5.2 Paschim Medinipur District: - Different weed species were collected from rice, potato, groundnut field from different blocks of Paschim Medinipur district.

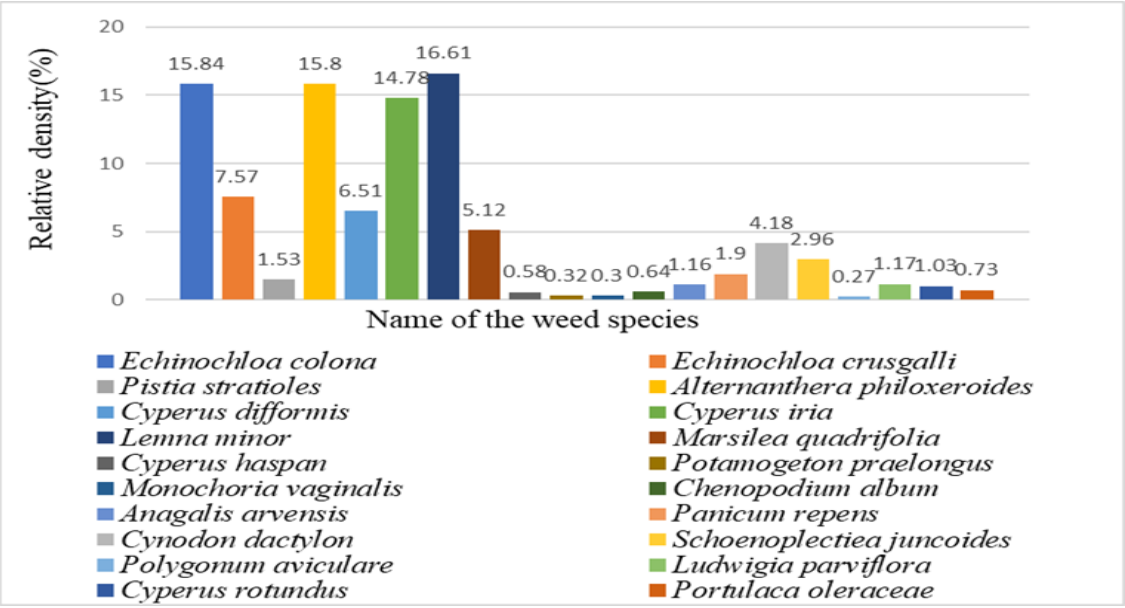
5.2.1 Rice: - A total number of 20 weed species were listed and analyzed from the survey of different rice fields from different blocks of Paschim Medinipur district. The most common family of the collected weed species were Poaceae, Amaranthaceae, Cyperaceae, Araceae etc. The result showed that the absolute density of weed flora in rice field of Paschim Medinipur district was 16.25, while the relative frequency and relative density of particular weed species ranged from 0.48% to 17.90% and 0.27% to 16.61% (Table no. 4)

The most relatively frequent weed species was *Echinochloa colona* (17.90%) followed by *Alternanthera philoxeroides* (16.86%) and the least relatively frequent weed with relative density of 0.48% were *Potamogeton praelongus, Monochoria vaginalis*. (Fig. 10)



(**Fig. 10: -** Relative frequency of weed species in rice field from Paschim Medinipur district.)

while the most relatively dominant weed species was *Lemna minor* (16.61%), followed by *Echinochloa colona* (15.84%) and *Alternanthera philoxeroides* (15.80%) and the least relative density was recorded by *Polygonum aviculare* (0.27%). (Fig. 11).



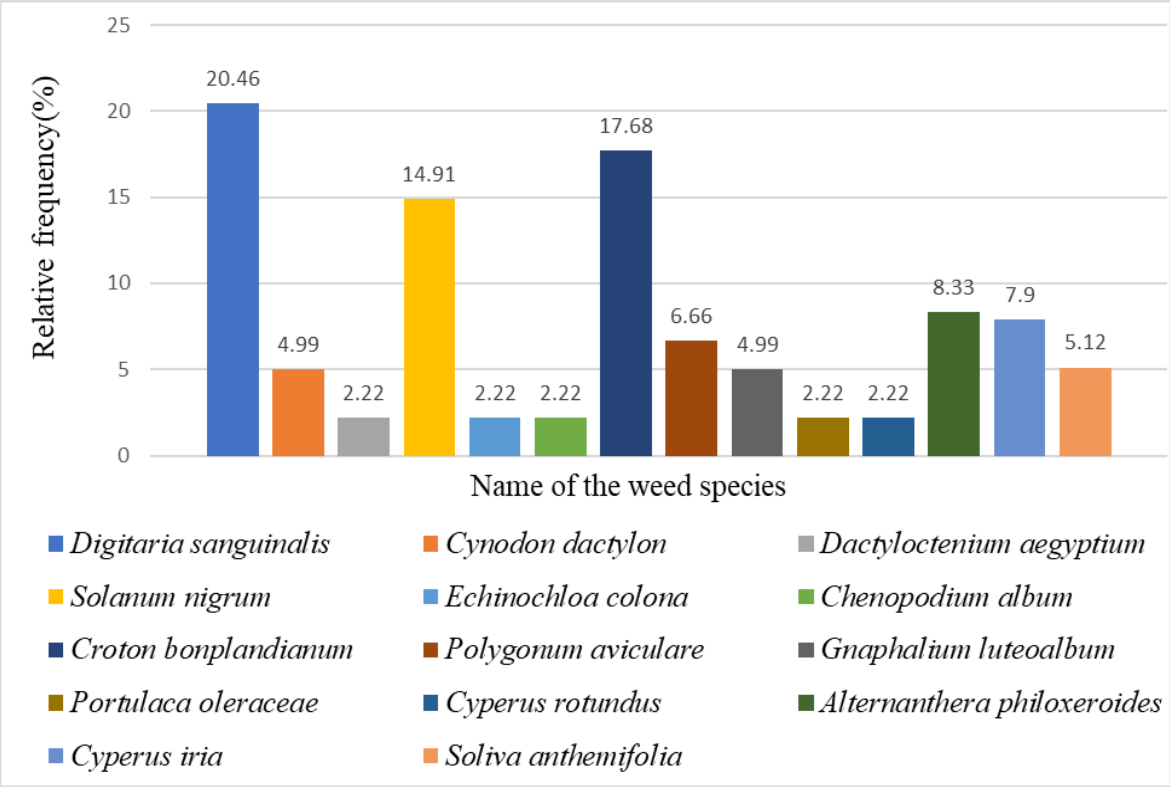
(**Fig. 11: -** Relative density of weed species in rice field from Paschim Medinipur district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density
Rice	Paschim Medinipur	16.25	*Echinochloa colona*	Poaceae	84.61	17.90	15.84
			Echinochloa crusgalli	Poaceae	38.45	8.02	7.57
			Pistia stratioles	Araceae	7.69	1.77	1.53
			Alternanthera philoxeroides	Amaranthacee	76.92	16.86	15.80
			Cyperus difformis	Cyperaceae	43.58	8.94	6.51
			Cyperus iria	Cyperaceae	64.09	13.71	14.78
			Lemna minor	Araceae	33.33	6.81	16.61
			Marsilea quadrifolia	Marsileaceae	28.20	5.59	5.12
			Cyperus haspan	Cyperaceae	5.12	1.06	0.58
			Potamogeton praelongus	Potamogetonaceae	2.56	0.48	0.32
			Monochoria vaginalis	Pontederiaceae	2.56	0.48	0.30
			Chenopodium album	Amaranthaceae	5.12	1.10	0.64
			Anagalis arvensis	Primulaceae	10.25	2.08	1.16
			Panicum repens	Poaceae	12.81	2.52	1.90
			Cynodon dactylon	Poaceae	28.20	5.75	4.18
			Schoenoplectiea juncoides	Cyperaceae	10.25	2.1	2.96
			Polygonum aviculare	Polygonaceae	2.56	0.45	0.27
			Ludwigia parviflora	Onagraceae	10.25	1.74	1.17
			Cyperus rotundus	Cyperaceae	7.69	1.57	1.03
			Portulaca oleraceae	Portulacaceae	5.12	1.02	0.73

(**Table 4: -** List of weeds of different rice field in Paschim Medinipur district.)

5.2.2 Potato: - A total number of 14 weed species were identified and collected during the survey in different potato fields from different blocks of Paschim Medinipur district. The most common families of the listed species were Poaceae, Amaranthaceae, Asteraceae, Euphorbiaceae, Solanaceae etc. The result showed that the absolute density of weed flora in potato field of Paschim Medinipur district was 13.99, while the relative frequency and relative density of particular weed species ranged from 2.22% to 20.46% and 1.14% to 25.44%. (Table. 5)

The most relatively frequent weed species was *Digitaria sanguinalis* (20.46%) followed by *Croton bonplandianum* (17.68%) and the least relative frequency (2.22%) was recorded by five weed species, *Dactyloctenium aegyptium, Echinochloa colona, Chenopodium album, Portulaca oleraceae and Cyperus rotundus*. (Fig. 12)

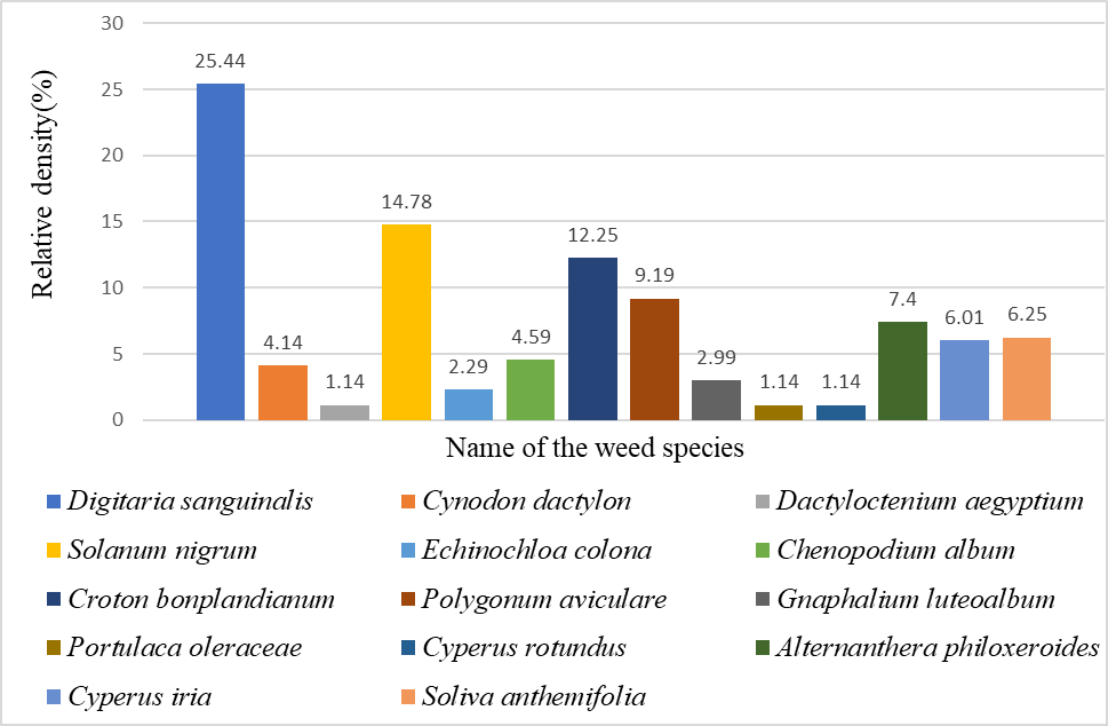


(**Fig. 12: -** Relative frequency of weed species in potato field from Paschim Medinipur district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Potato	Paschim Medinipur	13.99	*Digitaria sanguinalis*	Poaceae	88.88	20.46	25.44
			Cynodon dactylon	Poaceae	22.22	4.99	4.14
			Dactyloctenium aegyptium	Poaceae	11.11	2.22	1.14
			Solanum nigrum	Solanaceae	66.66	14.91	14.78
			Echinochloa colona	Poaceae	11.11	2.22	2.29
			Chenopodium album	Amaranthaceae	11.11	2.22	4.59
			Croton bonplandianum	Euphorbiaceae	77.77	17.68	12.25
			Polygonum aviculare	Polygonaceae	33.33	6.66	9.19
			Gnaphalium luteoalbum	Asteraceae	22.22	4.99	2.99
			Portulaca oleraceae	Portulacaceae	11.11	2.22	1.14
			Cyperus rotundus	Cyperaceae	11.11	2.22	1.14
			Alternanthera philoxeroides	Amaranthaceae	33.33	8.33	7.40
			Cyperus iria	Cyperaceae	33.33	7.90	6.01
			Soliva anthemifolia	Asteraceae	22.22	5.12	6.25

(**Table 5: -** List of weeds of different potato field in Paschim Medinipur district**.**)

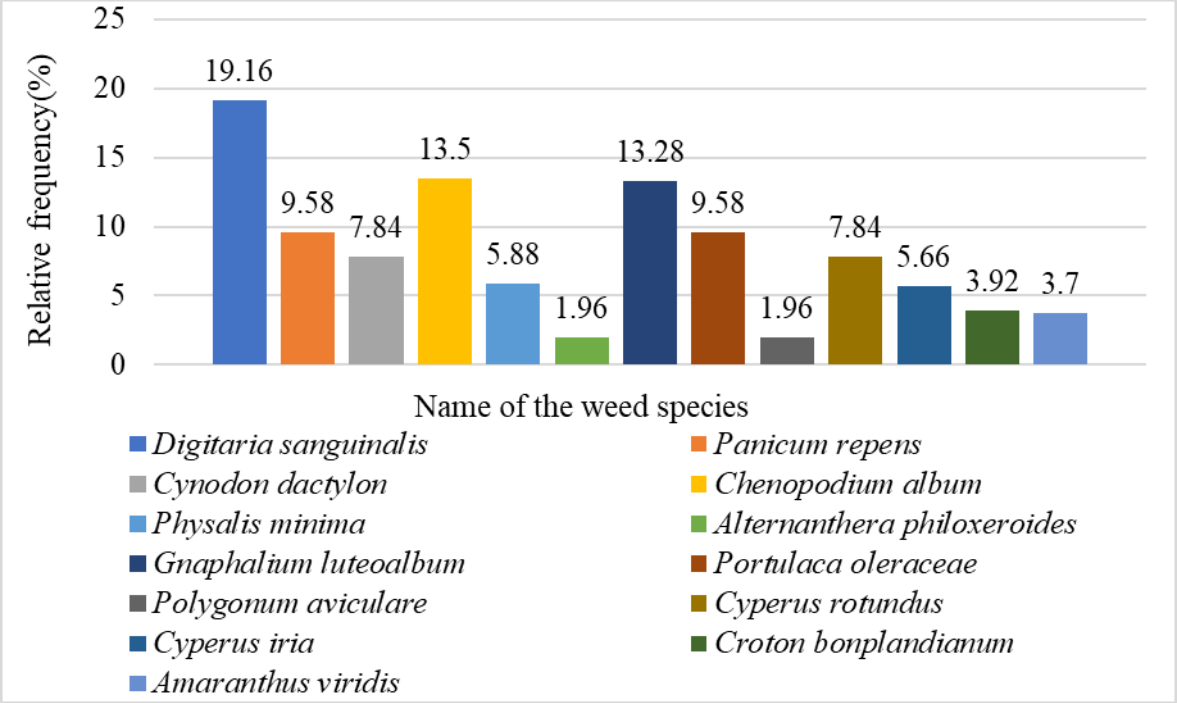
The most relatively dominant weed species was *Digitaria sanguinalis* (25.44%), followed by *Solanum nigrum* (14.78%) and the least relative density (1.14%) was recorded by *Dactyloctenium aegyptium, Portulaca oleraceae, Cyperus rotundus.* (Fig. 13)



(**Fig.13: -** Relative density of weed species in potato field from Paschim Medinipur district.)

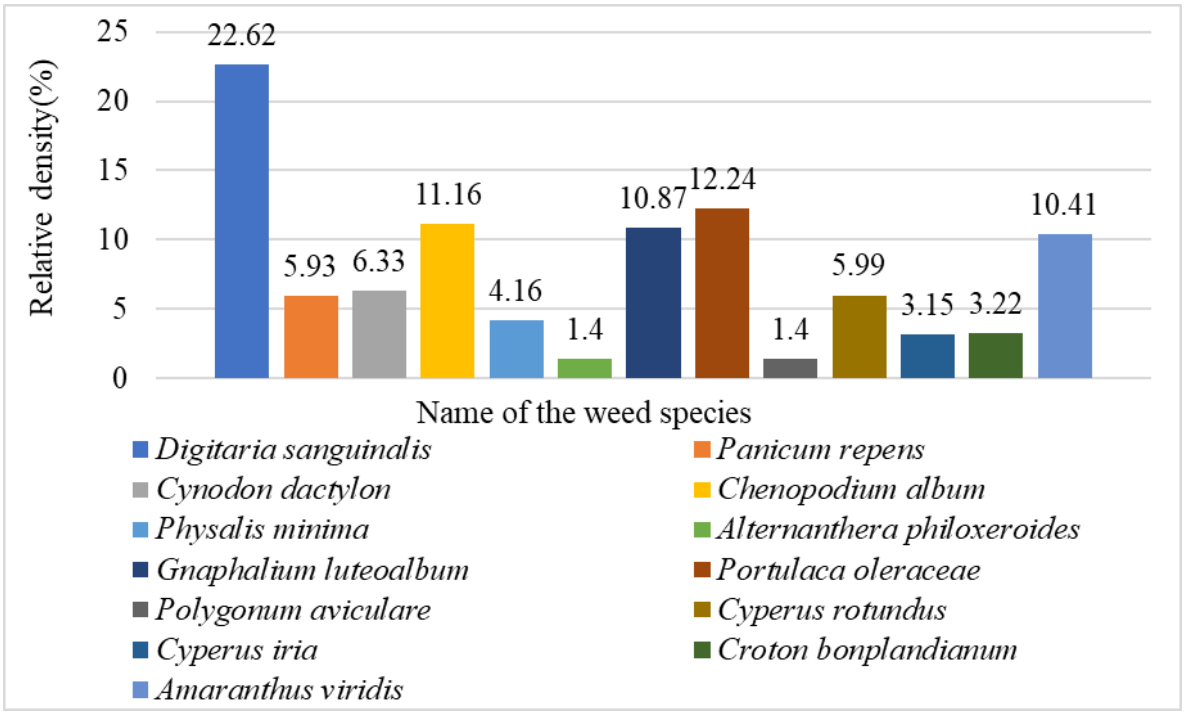
5.2.3 Groundnut: - A total number of 13 weed species were identified and collected during the survey in different groundnut fields from different blocks of Paschim Medinipur district. The most common families of the listed species were Poaceae, Amaranthaceae, Asteraceae, Polygonaceae, Solanaceae, Portulacaceae etc. The result showed that the absolute density of weed flora in groundnut field of Paschim Medinipur district was 17.55, while the relative frequency and relative density of particular weed species ranged from 1.96% to 19.16% and 1.40% to 22.62%.

The most relatively frequent weed species was *Digitaria sanguinalis* (19.16%) followed by *Chenopodium album* (13.50%) and the least relative frequency (1.96%) was recorded by two weed species, *Alternanthera philoxeroides* and *Polygonum aviculare.* (Fig.14)



(**Fig.14: -** Relative frequency of weed species in Groundnut field from Paschim Medinipur district.)

The most relatively dominant weed species was *Digitaria sanguinalis* (22.62%), followed by *Portulaca oleraceae* (12.24%) and the least relative density (1.40%) was recorded by *Alternanthera philoxeroides* and *Polygonum aviculare* (Fig.15).



(**Fig.15: -** Relative density of weed species in Groundnut field from Paschim Medinipur district.)

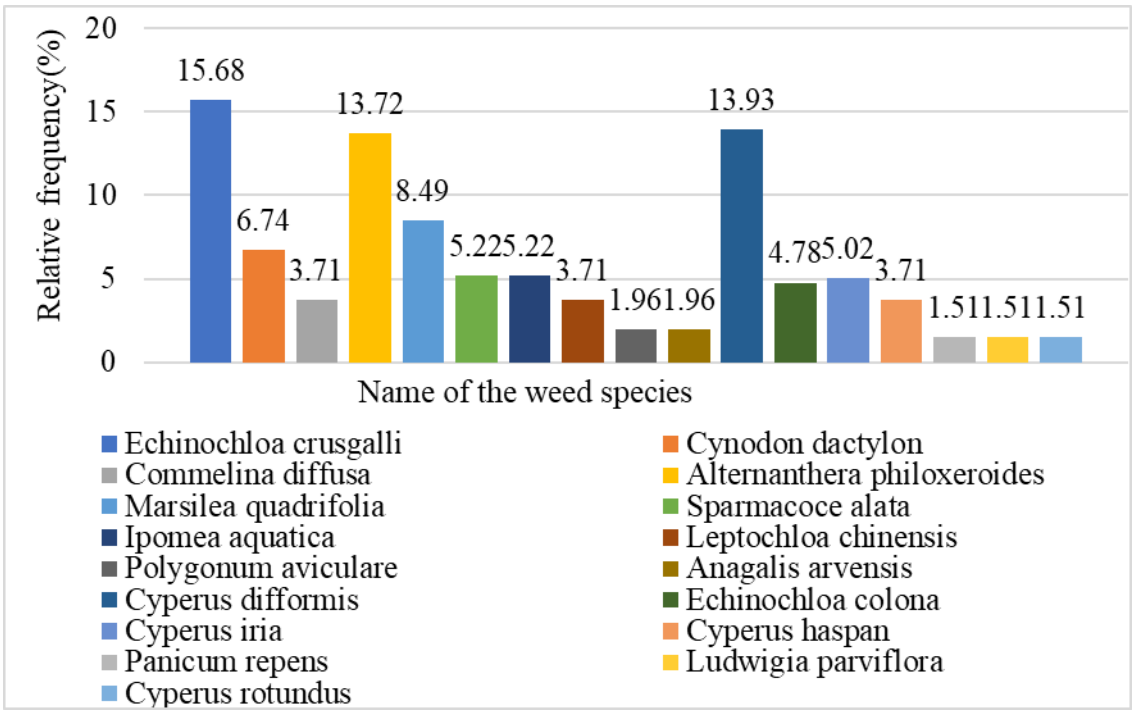
Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Groundnut	Paschim Medinipur	17.55	*Digitaria sanguinalis*	Poaceae	100	19.16	22.62
			Panicum repens	Poaceae	49.99	9.58	5.93
			Cynodon dactylon	Poaceae	44.44	7.84	6.33
			Chenopodium album	Amaranthaceae	72.22	13.50	11.16
			Physalis minima	Solanaceae	33.33	5.88	4.16
			Alternanthera philoxeroides	Amaranthaceae	11.11	1.96	1.40
			Gnaphalium luteoalbum	Asteraceae	66.66	13.28	10.87
			Portulaca oleraceae	Portulacaceae	49.99	9.58	12.24
			Polygonum aviculare	Polygonaceae	11.11	1.96	1.40
			Cyperus rotundus	Cyperaceae	44.44	7.84	5.99
			Cyperus iria	Cyperaceae	27.77	5.66	3.15
			Croton bonplandianum	Euphorbiaceae	22.22	3.92	3.22
			Amaranthus viridis	Amaranthaceae	16.66	3.70	10.41

(**Table 6: -** List of weeds of different Groundnut field in Paschim Medinipur district.)

5.3 South 24-Parganas District: - Different weed species were collected from rice, green gram, sesamum, groundnut, Chick pea field from different blocks of South 24-Parganasdistrict.

5.3.1 Rice: - A total number of 17 weed species were identified and collected during the survey in different rice fields from different blocks of South 24-Parganas district. The most common families of the listed species were Poaceae, Cyperaceae, Amaranthaceae, Marsileaceae, Convolvulaceae etc. The result showed that the absolute density of weed flora in rice field of South 24-Parganas district was 16.66, while the relative frequency and relative density of particular weed species ranged from 1.51% to 15.68% and 1.25% to 20.18%. (Table-7)

The most relatively frequent weed species was *Echinochloa crusgalli* (15.68%) followed by *Cyperus difformis* (13.93%) and the least relative frequency (1.51%) was recorded by three weed species, *Panicum repens, Ludwigia parviflora* and *Cyperus rotundus*. (Fig 16)

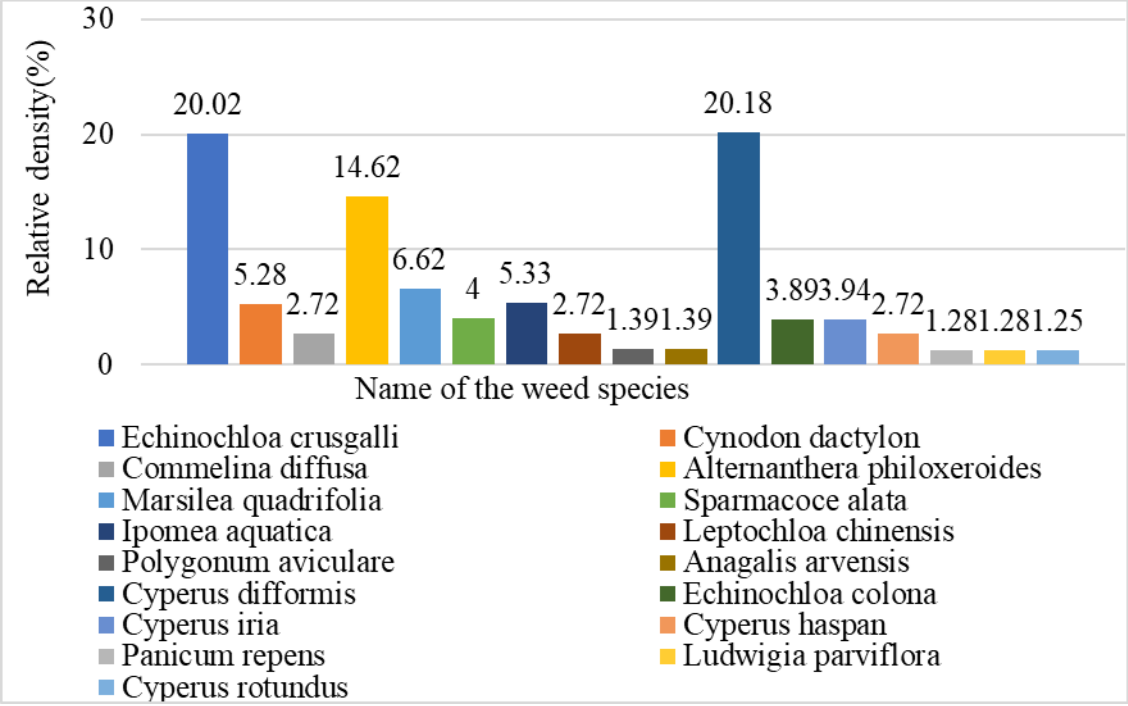


(**Fig.16: -** Relative frequency of weed species in rice field from South 24-Parganas district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Rice	South 24-Parganas	16.66	*Echinochloa crusgalli*	Poaceae	100	15.68	20.02
			Cynodon dactylon	Poaceae	44.44	6.74	5.28
			Commelina diffusa	Commelinaceae	22.22	3.71	2.72
			Alternanthera philoxeroides	Amaranthaceae	88.88	13.72	14.62
			Marsilea quadrifolia	Marsileaceae	55.55	8.49	6.62
			Sparmacoce alata	Rubiaceae	33.33	5.22	4
			Ipomea aquatica	Convolvulaceae	33.33	5.22	5.33
			Leptochloa chinensis	Poaceae	22.22	3.71	2.72
			Polygonum aviculare	Polygonaceae	11.11	1.96	1.39
			Anagalis arvensis	Primulaceae	11.11	1.96	1.39
			Cyperus difformis	Cyperaceae	88.88	13.93	20.18
			Echinochloa colona	Poaceae	33.33	4.78	3.89
			Cyperus iria	Cyperaceae	33.33	5.02	3.94
			Cyperus haspan	Cyperaceae	22.22	3.71	2.72
			Panicum repens	Poaceae	11.33	1.51	1.28
			Ludwigia parviflora	Onagraceae	11.33	1.51	1.28
			Cyperus rotundus	Cyperaceae	11.11	1.51	1.25

(**Table 7: -** List of weeds of different Rice field in South 24-Parganas district.)

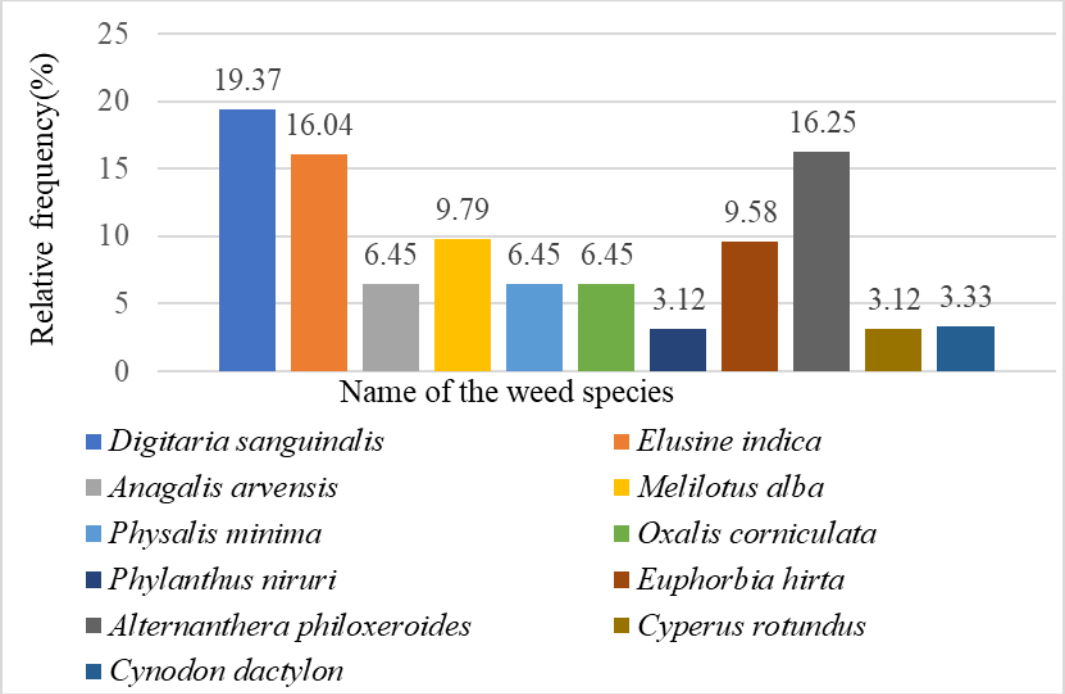
The most relatively dominant weed species was *Cyperus difformis* (20.18%), followed by *Echinochloa crusgalli* (20.02%) and the least relative density (1.25%) was recorded by *Cyperus rotundus*. (Fig 17)



(**Fig.17: -** Relative density of weed species in rice field from South 24-Parganas district.)

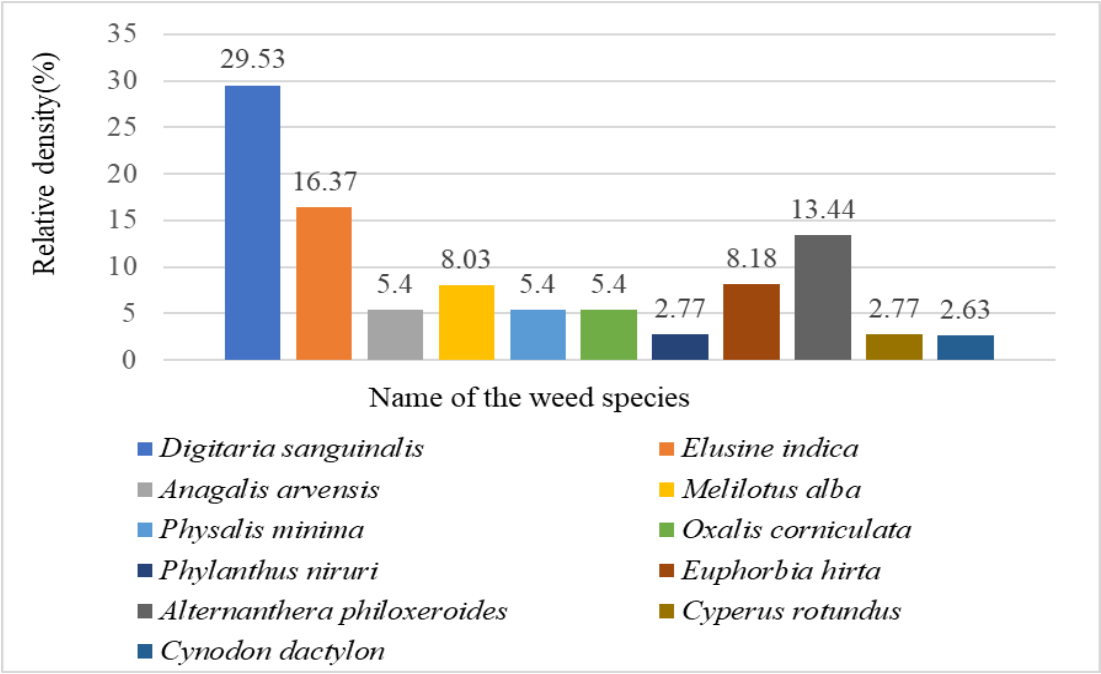
5.3.2 Groundnut: - A total number of 11 weed species were identified and collected during the survey in different groundnut fields from different blocks of South 24-Parganas district. The most common families of the listed species were *Poaceae, Primulaceae, Fabaceae, Amaranthaceae, Euphorbiaceae* etc. The result showed that the absolute density of weed flora in groundnut field of South 24-Parganas district was 12.33, while the relative frequency and relative density of particular weed species ranged from 3.12% to 19.37% and 2.63% to 29.53% respectively. (Table-8)

The most relatively frequent weed species was *Digitaria sanguinalis* (19.37%) followed by *Alternanthera philoxeroides* (16.25%) and the least relative frequency (3.12%) was recorded by two weed species, *Phylanthus niruri* and *Cyperus rotundus*. (Fig. 18)



(**Fig.18: -** Relative frequency of weed species in Groundnut field from South 24-Parganas district.)

The most relatively dominant weed species was *Digitaria sanguinalis* (29.53%), followed by *Elusine indica* (16.37%) and the least relative density (2.63%) was recorded by *Cynodon dactylon*. (Fig. 19)



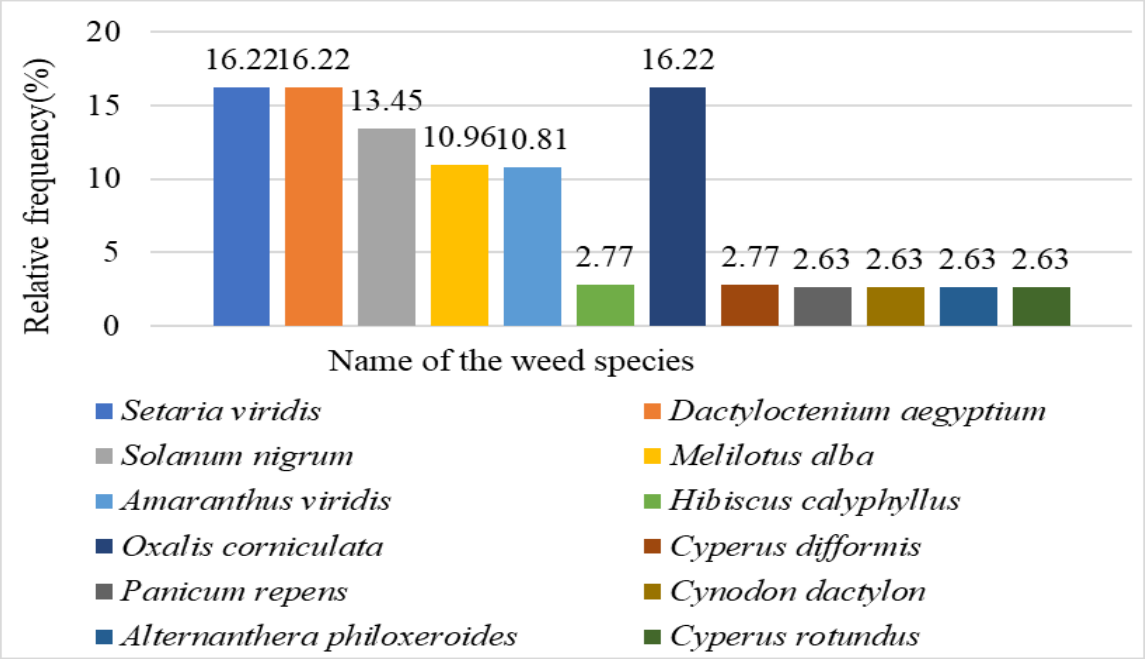
(**Fig.19: -** Relative density of weed species in Groundnut field from South 24-Parganas district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Groundnut	South 24 Parganas	12.33	*Digitaria sanguinalis*	Poaceae	100	19.37	29.53
			Elusine indica	Poaceae	83.33	16.04	16.37
			Anagalis arvensis	Primulaceae	33.33	6.45	5.40
			Melilotus alba	Fabaceae	49.99	9.79	8.03
			Physalis minima	Solanaceae	33.33	6.45	5.40
			Oxalis corniculata	Oxalidaceae	33.33	6.45	5.40
			Phylanthus niruri	Phyllanthaceae	16.66	3.12	2.77
			Euphorbia hirta	Euphorbiaceae	49.99	9.58	8.18
			Alternanthera philoxeroides	Amaranthaceae	83.33	16.25	13.44
			Cyperus rotundus	Cyperaceae	16.66	3.12	2.77
			Cynodon dactylon	Poaceae	16.66	3.33	2.63

(**Table 8: -** List of weeds of different groundnut field in South 24-Parganas district.)

5.3.3 Chickpea: - A total number of 12 weed species were identified and collected during the survey in different chickpea fields from different blocks of South 24-Parganas district. The most common families of the listed species were Poaceae, Solanaceae, Oxadilaceae, Fabaceae, Malvaceae, Amaranthaceae etc. The result showed that the absolute density of weed flora in groundnut field of South 24 Pargana district was 17, while the relative frequency and relative density of particular weed species ranged from 2.63% to 16.22% and 1.85% to 21.52%. (Table-9)

The most relatively frequent weed species with the relative frequency of 16.22% was recorded by three weed species were *Setaria viridis*, *Dactyloctenium aegyptium*, *Oxalis corniculata* followed by *Solanum nigrum* (13.45%) and the least relative frequency (2.63%) was recorded by four weed species *Panicum repens*, *Cynodon dactylon*, *Alternanthera philoxeroides* and *Cyperus rotundus*. (Fig. 20)

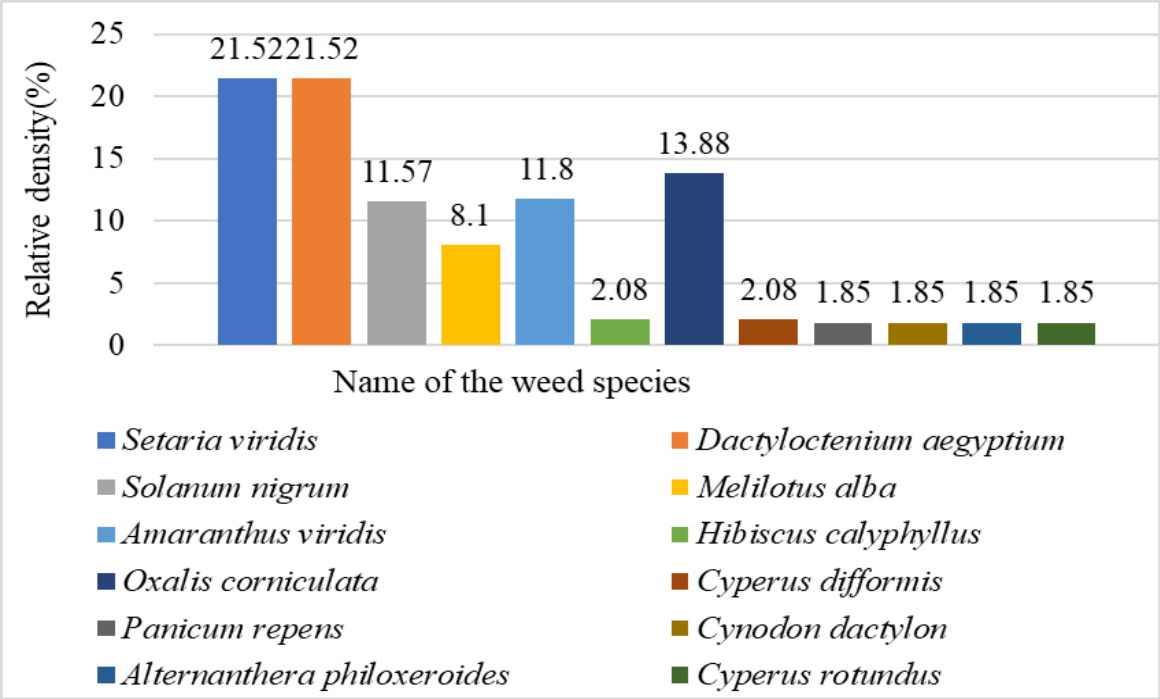


(**Fig.20: -** Relative frequency of weed species in Chickpea field from South 24-Parganas district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Chickpea	South 24 Pargana	17	*Setaria viridis*	Poaceae	100	16.22	21.52
			Dactyloctenium aegyptium	Poaceae	100	16.22	21.52
			Solanum nigrum	Solanaceae	83.33	13.45	11.57
			Melilotus alba	Fabaceae	66.66	10.96	8.1
			Amaranthus viridis	Amaranthaceae	66.66	10.81	11.80
			Hibiscus calyphyllus	Malvaceae	16.66	2.77	2.08
			Oxalis corniculata	Oxalidaceae	100	16.22	13.88
			Cyperus difformis	Cyperaceae	16.66	2.77	2.08
			Panicum repens	Poaceae	16.66	2.63	1.85
			Cynodon dactylon	Poaceae	16.66	2.63	1.85
			Alternanthera philoxeroides	Amaranthaceae	16.66	2.63	1.85
			Cyperus rotundus	Cyperaceae	16.66	2.63	1.85

(**Table 9: -** List of weeds of different Chickpea field in South 24-Parganas district.)

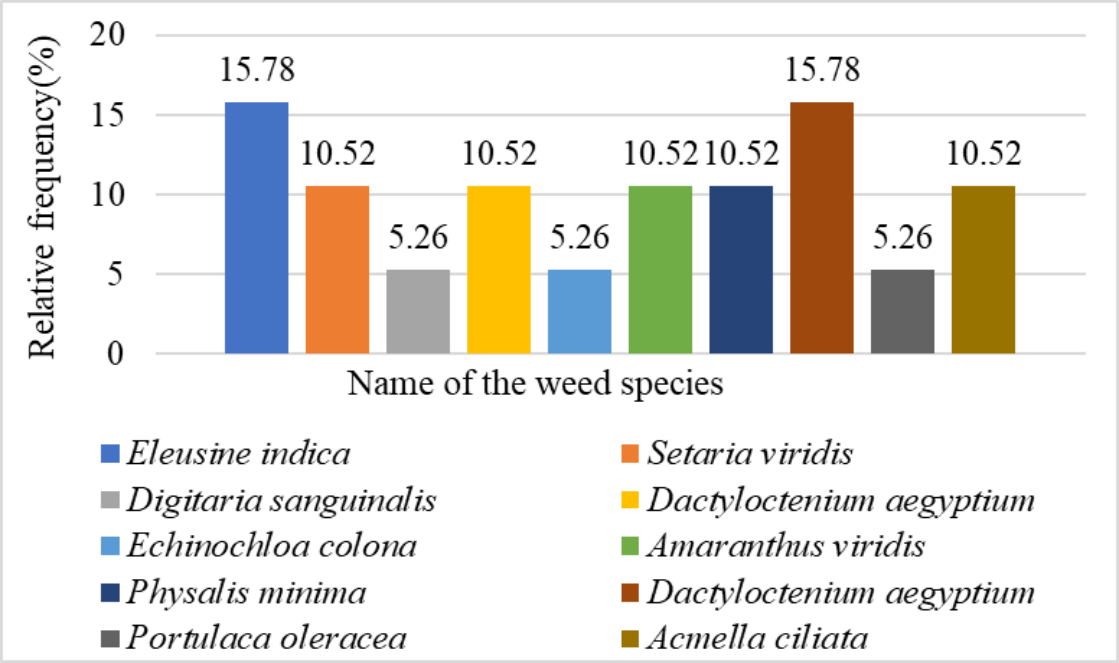
The most relatively dominant weed species with relative density of 21.52% were Setaria viridis, Dactyloctenium aegyptium followed by Oxalis corniculata (1.85%) and the least relative density (1.85%) was recorded by four weed species Panicum repens, Cynodon dactylon, Alternanthera philoxeroides and Cyperus rotundus. (Fig. 21)



(**Fig.21: -** Relative density of weed species in Chickpea field from South 24-Parganas district.)

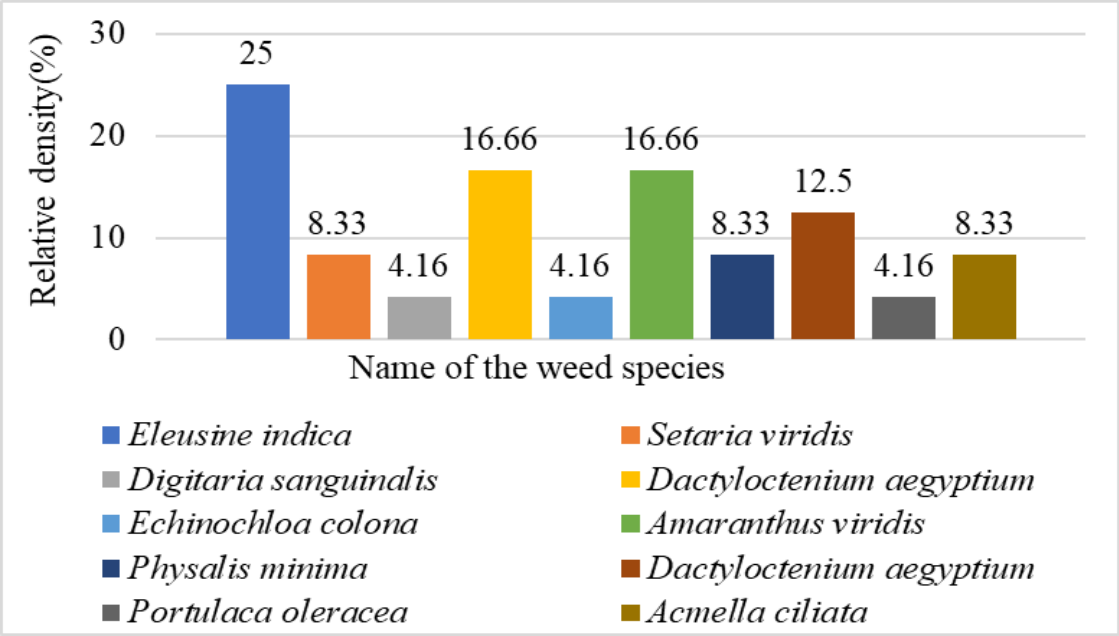
5.3.4 Green gram: - A number of 10 weed species were identified and analyzed from different Greengram field from different blocks of South 24-Parganas district. The most common families according to the number of represented spices were Poaceae, Amaranthaceae, Solanaceae etc. The result showed that the that the absolute density of weed flora in Greengram field of South 24 Parganas district was 16. The relative frequency and relative density of particular weed species ranged from 5.26% to 15.78% and 4.16% to 25% respectively. (Table-10)

The most relatively frequent weed species was *Elusine indica* (15.78%) and *Dactyloctenium aegyptium* (15.78%) followed by *Physalis minima* (10.52%), *Dactyloctenium aegyptium* (10.52%), *Setaria viridis* (10.52%), *Acmella ciliata* (10.52%), *Amaranthus viridis* (10.52%) and the least relative frequency was reported by *Digiteria sanguinalis* (5.26%), *Echinochloa colona* (5.26%) and *Portulaca oleracea* (5.26%). (Fig. 22)



(**Fig.22: -** Relative frequency of weed species in Green gram field from South 24-Parganas district.)

The most relatively dominant weed species was *Elusine indica* (25%) followed by *Dactyloctenium aegyptium* (16.66%) *and Amaranthus viridis* (16.66%), whereas the least relative density 4.16% was reported by *Digitaria sanguinalis*, *Echinochloa colona*, and *Portulaca oleracea*. (Fig. 23)



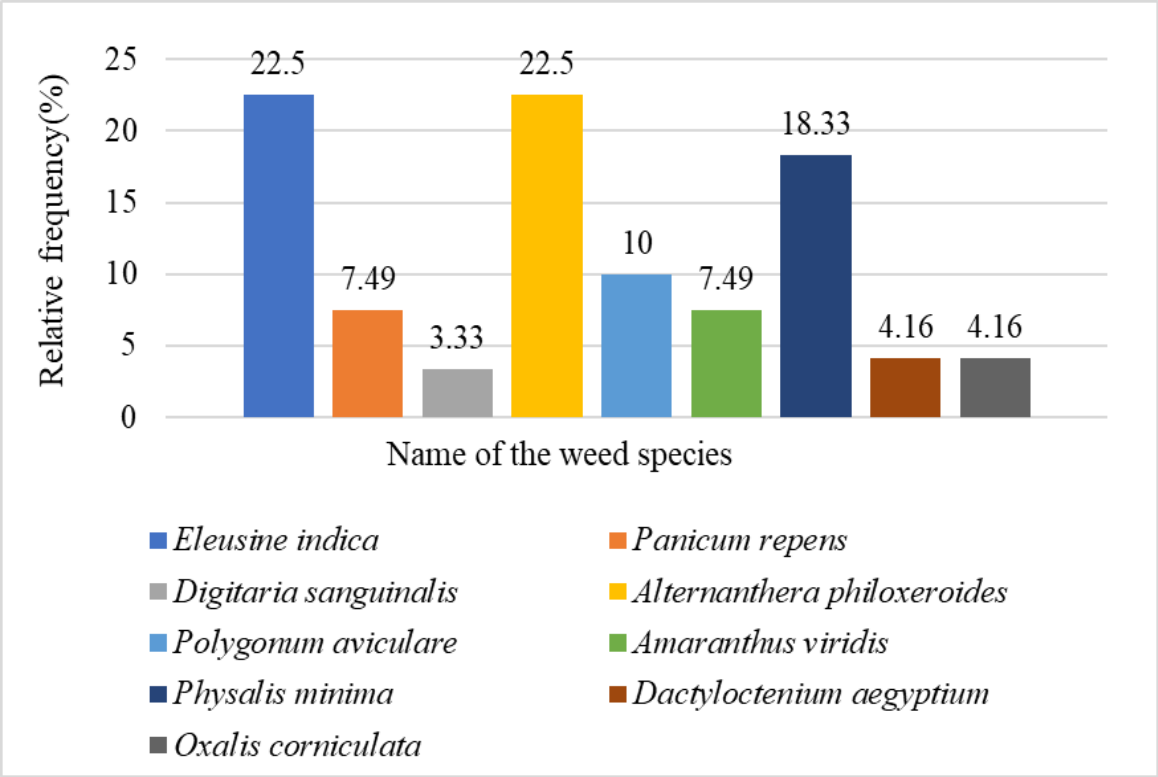
(**Fig.23: -** Relative density of weed species in Green gram field from South 24-Parganas district.)

Crop	District	Absolute Density (No. of weeds/m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Greengram	South 24-Parganas	16	*Eleusine indica*	Poaceae	100	15.78	25
			Setaria viridis	Poaceae	66.66	10.52	8.33
			Digitaria sanguinalis	Poaceae	33.33	5.26	4.16
			Dactyloctenium aegyptium	Amaranthaceae	66.66	10.52	16.66
			Echinochloa colona	Poaceae	83.33	5.26	4.16
			Amaranthus viridis	Amaranthaceae	66.66	10.52	16.66
			Physalis minima	Solanaceae	66.66	10.52	8.33
			Dactyloctenium aegyptium	Poaceae	100	15.78	12.5
			Portulaca oleracea	Portulacaceae	33.33	5.26	4.16
			Acmella ciliata	Asteraceae	66.66	10.52	8.33

(**Table 10: -** List of weeds of different Greengram field in South 24-Parganas district.)

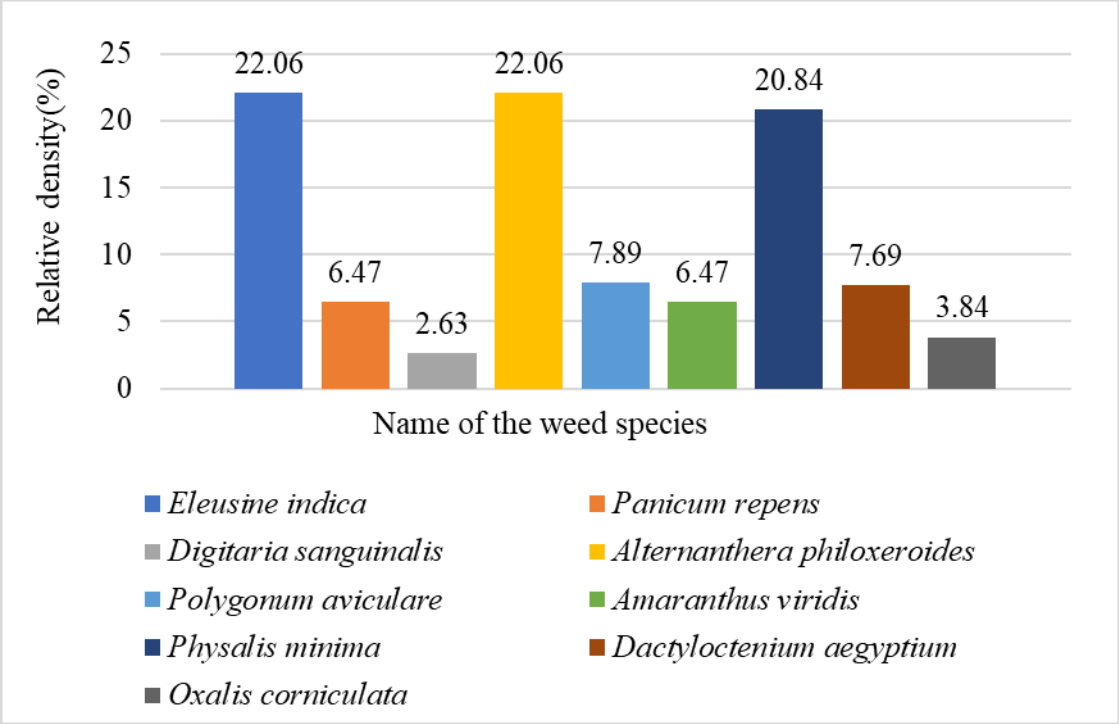
5.3.5 Sesamum: - A number of 9 weed species were identified and collected from different sesamum field from different blocks of South 24-Parganas district. The most common families according to the number of represented species were Poaceae, Amaranthaceae, Solanaceae, polygonaceae, Oxalidaceae etc. The result showed that the absolute density of weed flora in sesamum field of South 24 Parganas district was 10.66. The relative frequency and relative density of particular weed species ranged from 3.33% to 22.5% and 2.63% to 22.06% respectively. (Table-11)

The most relatively frequent weed species was *Elusine indica* (22.5%) and *Alternanthera philoxeroides* (22.5%) followed by *Physalis minima* (18.88%) and least relative frequency was recorded by *Digitaria sanguinalis* (3.33%). (Fig. 24)



(**Fig.24: -** Relative frequency of weed species in Sesamum field from South 24-Parganas district.)

The most relatively dominant weed species was *Elusine indica* (22.06%) and *Alternanthera philoxeroides* (22.06%) followed by *Physalis minima* (20.84%) and the least relative density was shown by *Digitaria sanguinalis* (2.63%). (Fig. 25)



(**Fig.25:** - Relative density of weed species in Sesamum field from South 24-Parganas district.)

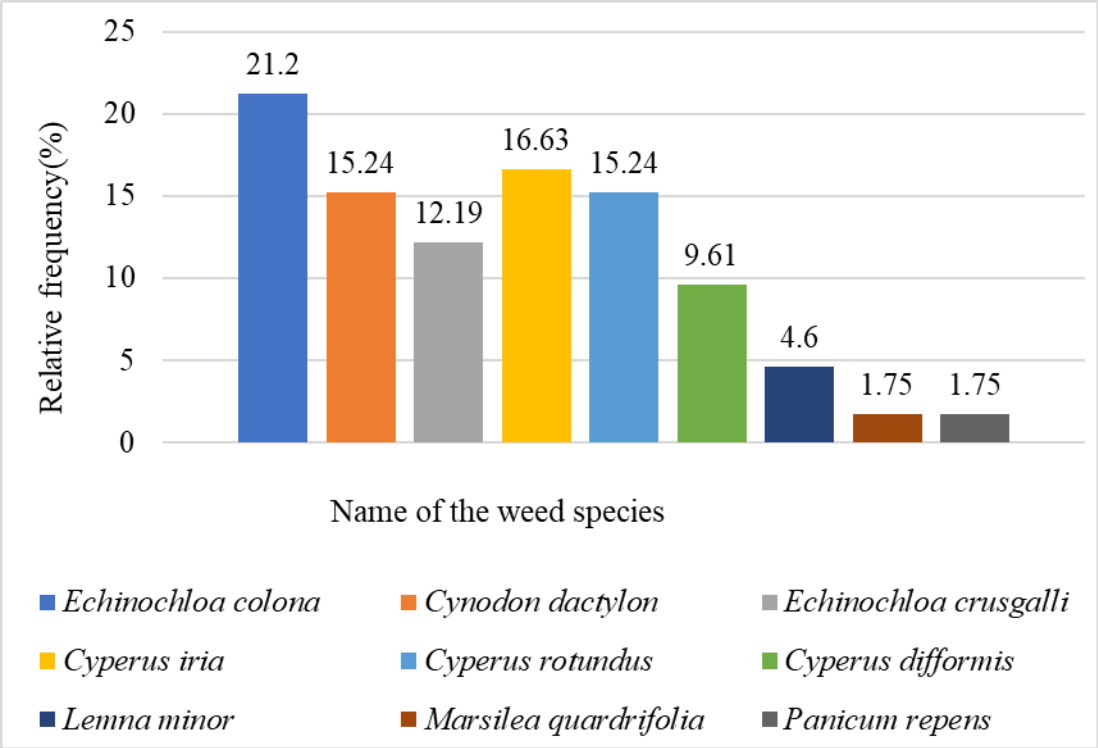
Crop	District	Absolute Density (No. of weeds/m^2)	Name of the weed spices	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Sesamum	South 24-Parganas	10.66	*Eleusine indica*	Poaceae	100	22.5	22.06
			Panicum repens	Poaceae	33.33	7.49	6.47
			Digitaria sanguinalis	Poaceae	16.66	3.33	2.63
			Alternanthera philoxeroides	Amaranthaceae	100	22.5	22.06
			Polygonum aviculare	Polygonaceae	50	10	7.89
			Amaranthus viridis	Amaranthaceae	16.66	7.49	6.47
			Physalis minima	Solanaceae	83.33	18.33	20.84
			Dactyloctenium aegyptium	Poaceae	16.66	4.16	7.69
			Oxalis corniculata	Oxalidaceae	16.66	4.16	3.84

(**Table 11: -** List of weeds of different Sesamum field in South 24-Parganas district.)

5.4 Birbhum District: - Different weed species were collected from rice, green gram, sesamum, groundnut, Chick pea field from different blocks of Birbhum district.

5.4.1 Rice: - A number of 9 weed species were identified from different rice field from different blocks of birbhum district. The most common families according to the number of represented species were Poaceae, Cyperaceae, Marsileaceae, Araceae. The result showed that the absolute density of weed flora in rice field of Birbhum district was 13.88. The relative frequency and relative density of particular weed species ranged from 1.75% to 21.20% and 1.58% to 27.65% respectively. (Table-12)

The most relatively frequent weed species was *Echinochloa colona* (21.20%) followed by *Cyperus iria* (16.63%) and the least relative frequency was reported by *Marsilea quardrifolia* (1.75%) and *Panicum repens* (1.75%). (Fig. 26)

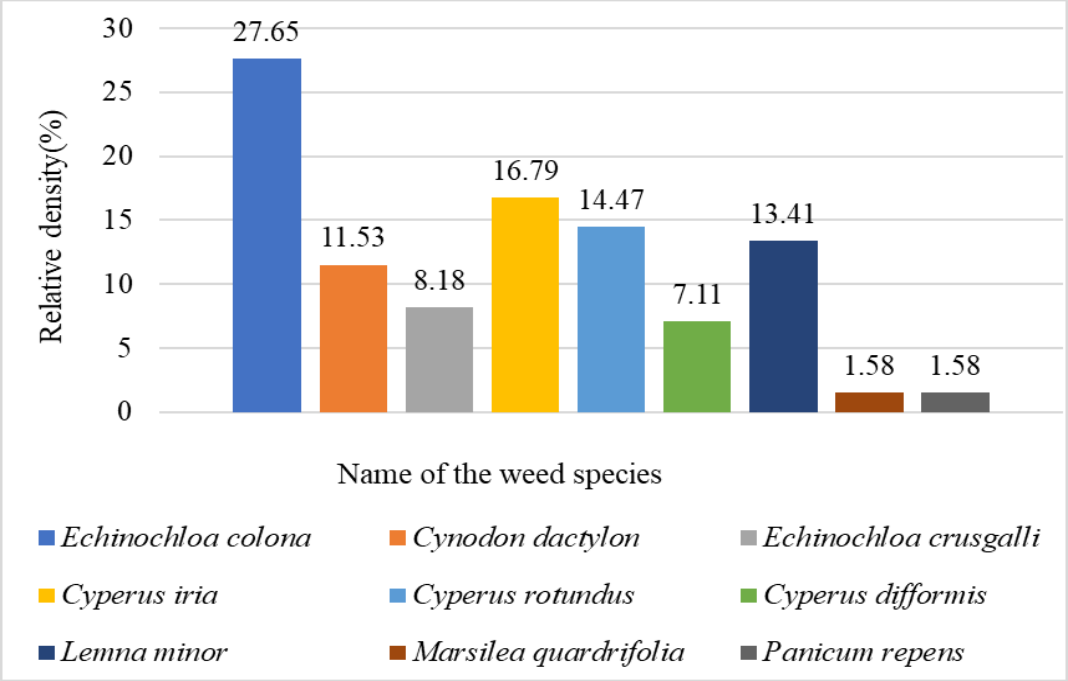


(**Fig.26: -** Relative frequency of weed species in Rice field from Birbhum district.)

Crop	District	Absolute Density (No. of weeds/m^2)	Name of the weed spices	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Rice	Birbhum	13.88	*Echinochloa colona*	Poaceae	94.44	21.20	27.65
			Cynodon dactylon	Poaceae	66.66	15.24	11.53
			Echinochloa crusgalli	Poaceae	55.55	12.19	8.18
			Cyperus iria	Cyperaceae	72.21	16.63	16.79
			Cyperus rotundus	Cyperaceae	66.66	15.24	14.47
			Cyperus difformis	Cyperaceae	44,44	9.61	7.11
			Lemna minor	Araceae	22.22	4.60	13.41
			Marsilea quardrifolia	Marsileaceae	11.11	1.75	1.58
			Panicum repens	Poaceae	11.11	1.75	1.58

(**Table 12: -** List of weeds of different Rice field in Birbhum district.)

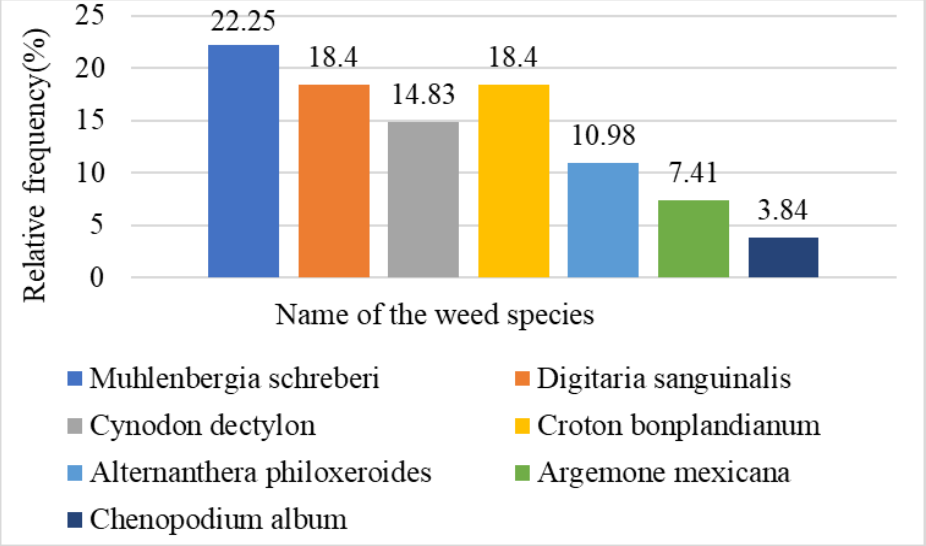
The most relatively dominant weed species was *Echinochloa colona* (27.65%) followed by *Cyperus iria* (16.79%) and the least relative density was reported by *Marsilea quardrifolia* (1.58%) and *Panicum repens* (1.58%). (Fig. 27)



(**Fig.27: -** Relative density of weed species in Rice field from Birbhum district.)

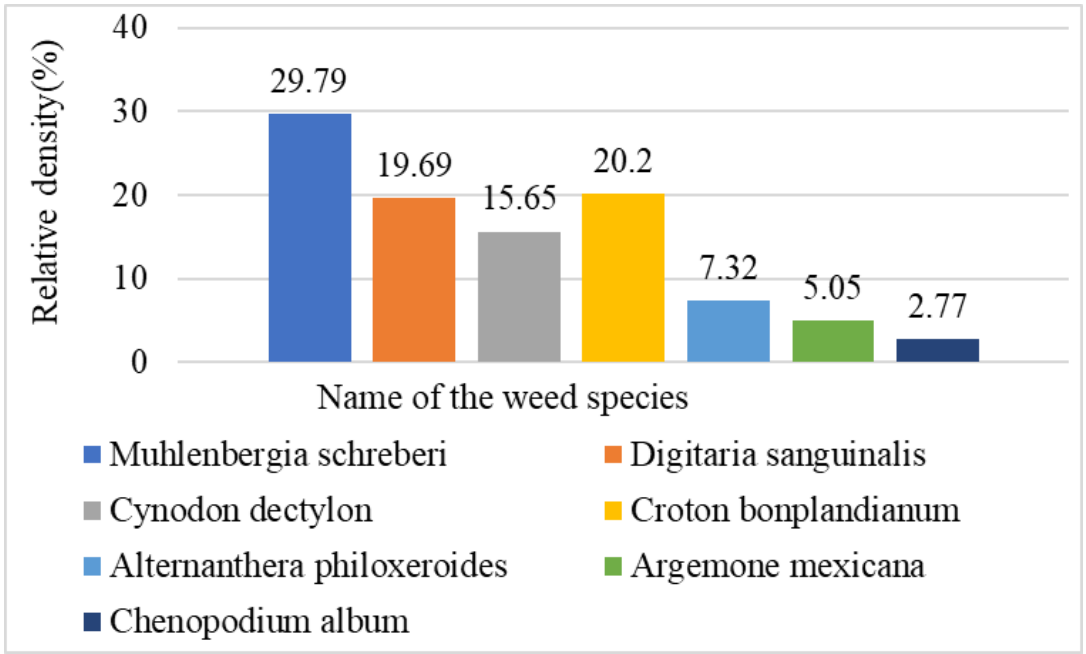
5.4.1 Mustard: - A number of 7 weed species were identified from different Mustard field from different blocks of Birbhum district. The most common families according to the number of represented spices were Poaceae, Amaranthaceae, Euphorbiaceae etc. The result showed that the that the absulute density of weed flora in mustard field of Birbhum district was 13.33. The relative frequency and relative density of particular weed species ranged from 3.84% to 22.25% and 2.77% to 29.79% respectively. (Table-13)

The most relatively frequent weed species was *Muhlenbergia schreberi* (22.25%) followed by *Digitaria sanguinalis* (18.40%) and *Croton bonplandianum* (18.40%) and the least relative frequency was recorded by *Chenopodium album* (3.84%). (Fig. 28)



(**Fig.28: -** Relative frequency of weed species in Mustard field from Birbhum district.)

The most relatively dominant weed species was *Muhlenbergia schreberi* (29.79%) followed by *Croton bonplandianum* (20.20%) and least relative density was shown by *Chenopodium album* (2.77%). (Fig. 29)



(**Fig.29: -** Relative density of weed species in Mustard field from Birbhum district.)

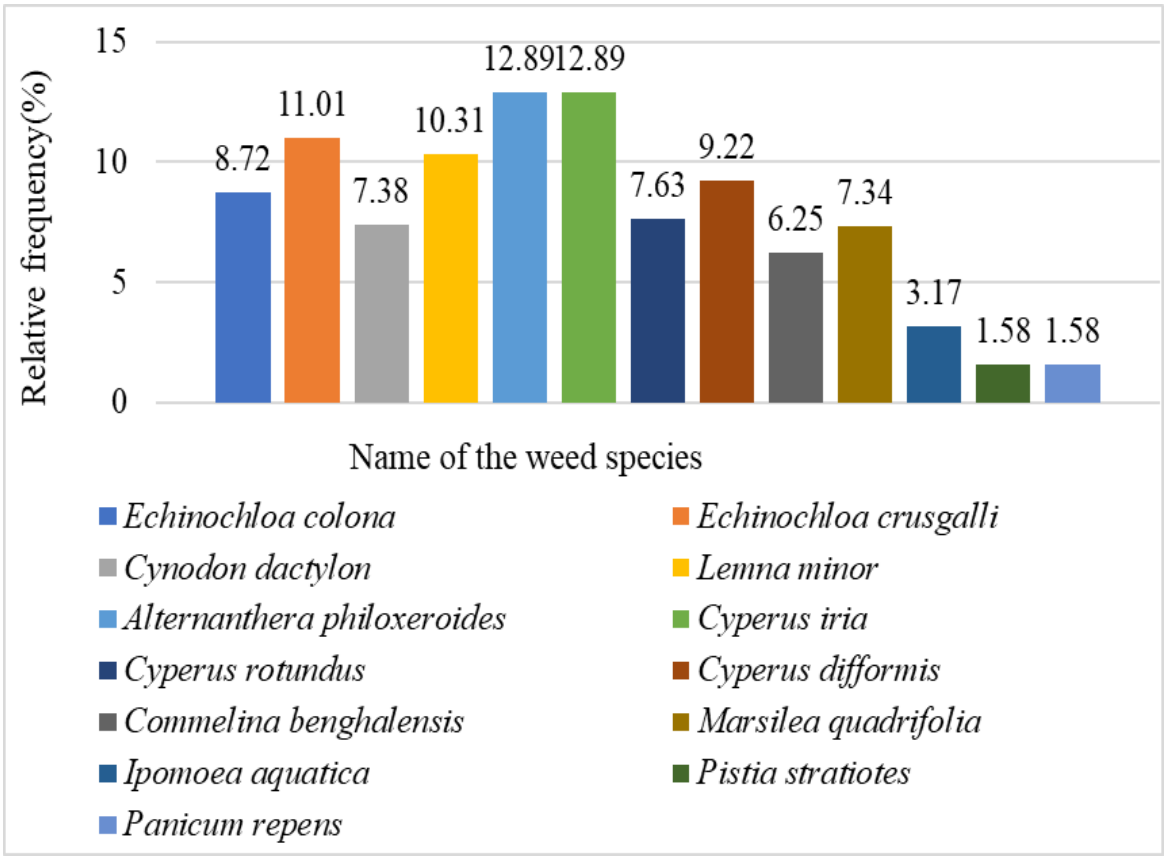
Crop	District	Absolute Density (No. of weeds/m^2)	Name of the weed spices	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Mustard	Birbhum	13.33	*Muhlenbergia schreberi*	Poaceae	100	22.25	29.79
			Digitaria sanguinalis	Poaceae	83.33	18.40	19.69
			Cynodon dectylon	Poaceae	66.66	14.83	15.65
			Croton bonplandianum	Euphorbiaceae	83.33	18.40	20.20
			Alternanthera philoxeroides	Amaranthaceae	49.99	10.98	7.32
			Argemone mexicana	papaveraceae	33.33	7.41	5.05
			Chenopodium album	Amaranthaceae	16.66	3.84	2.77

(**Table 13: -** List of weeds of different Mustard field in Birbhum district.)

5.5 Purba Medinipur District: - Different weed species were collected from rice, groundnut, mustard, potato field from different blocks of Purba Medinipur district.

5.5.1 Rice: - A total number of 13 weed species were identified from different rice field from different blocks of Purba Medinipur district. The most common families according to the number of represented species were Poaceae, Cyperaceae, Marsileaceae, Araceae, Amaranthaceae etc. The result showed that the absolute density of weed flora in rice field of Purba Medinipur district was 27.99. The relative frequency and relative density of particular weed species ranged from 1.58% to 12.89% and 0.81% to 22.53% respectively. (Table-14)

The most relatively frequent weed species were *Alternanthera philoxeroides* and *Cyperus iria* with the relative frequency of 12.89%, followed by *Echinochloa crusgalli* (11.01%) and the least relative frequency was reported by Pistia stratiotes and *Panicum repens* with the relative frequency of 1.58%. (Fig. 30)

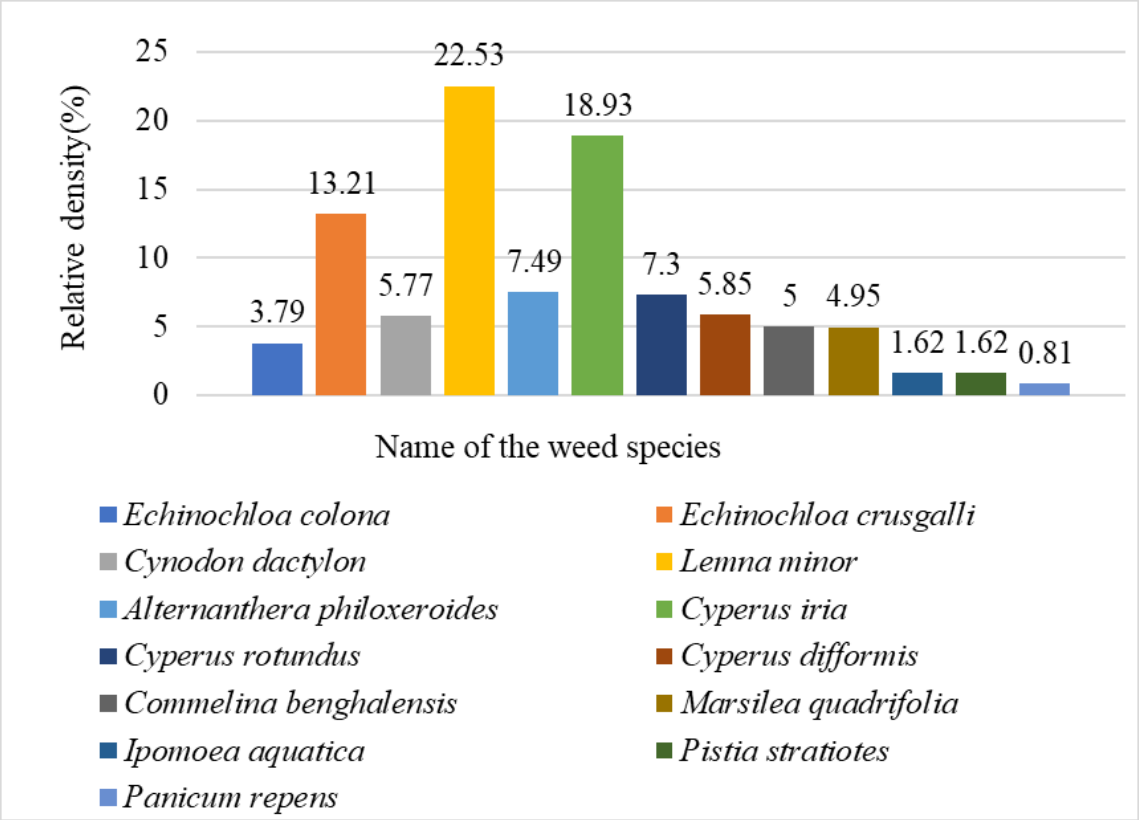


(**Fig. 30: -** Relative frequency of weed species in Rice field from Purba Medinipur district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Rice	Purba Medinipur	27.99	Echinochloa colona	Poaceae	44.44	8.72	3.79
			Echinochloa crusgalli	Poaceae	66.66	11.01	13.21
			Cynodon dactylon	Poaceae	44.44	7.38	5.77
			Lemna minor	Araceae	55.55	10.31	22.53
			Alternanthera philoxeroides	Amaranthaceae	66.66	12.89	7.49
			Cyperus iria	Cyperaceae	66.66	12.89	18.93
			Cyperus rotundus	Cyperaceae	33.33	7.63	7.30
			Cyperus difformis	Cyperaceae	44.44	9.22	5.85
			Commelina benghalensis	Commelinaceae	33.33	6.25	5
			Marsilea quadrifolia	Marsileaceae	44.44	7.34	4.95
			Ipomoea aquatica	Convolvulaceae	22.22	3.17	1.62
			Pistia stratiotes	Araceae	11.11	1.58	1.62
			Panicum repens	Poaceae	11.11	1.58	0.81

(**Table 14: -** List of weeds of different Rice field in Purba Medinipur district.)

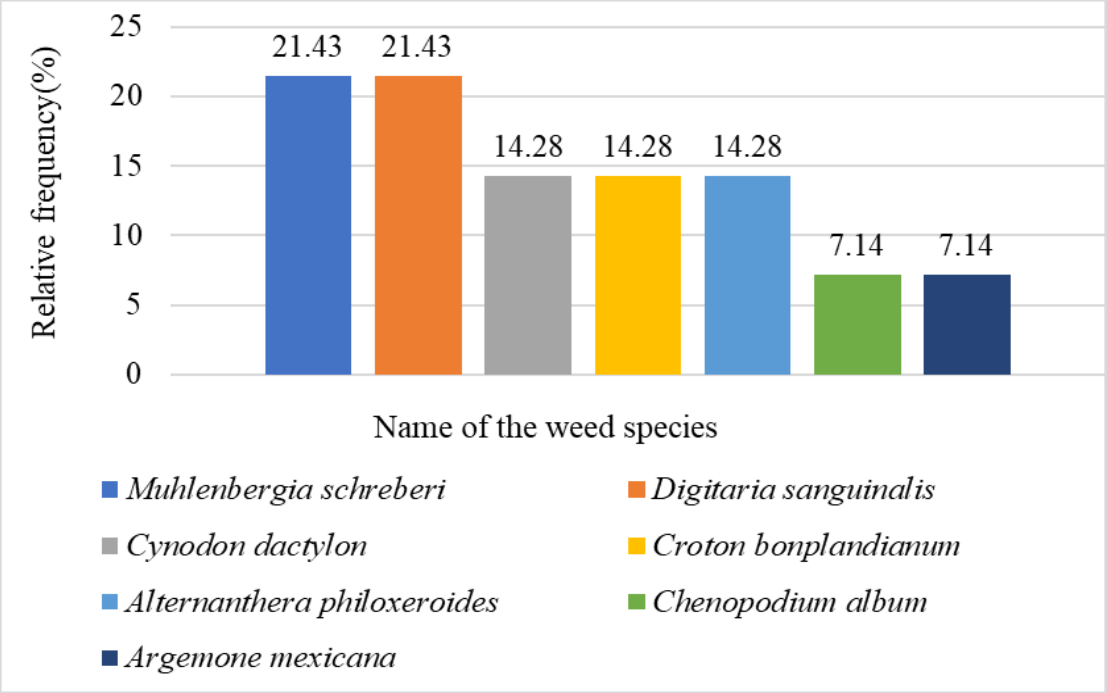
The most relatively dominant weed species was *Lemna minor* (22.53%) followed by *Cyperus iria* (18.93%) and least relative density was shown by *Panicum repens* (0.81%). (Fig. 31)



(**Fig. 31: -** Relative density of weed species in Rice field from Purba Medinipur district.)

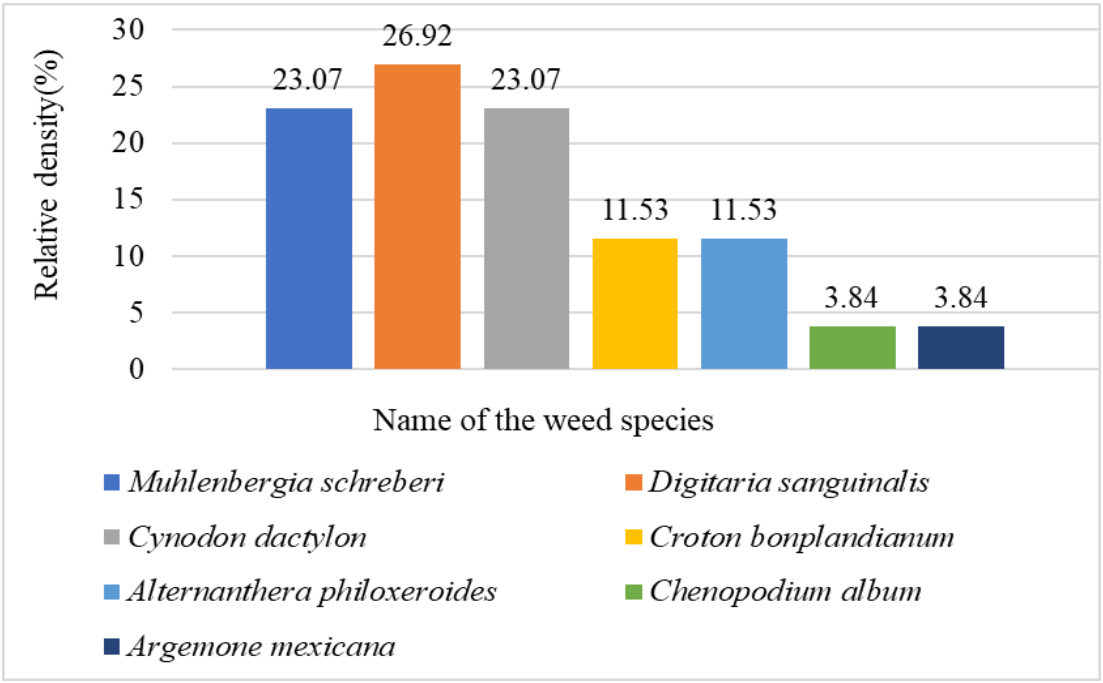
5.5.2 Mustard: - A total number of 7 weed species were identified from different mustard field from different blocks of Purba Medinipur district. The most common families according to the number of represented species were Poaceae, Euphorbiaceae, Papaveraceae and Amaranthaceae. The result showed that the absolute density of weed flora in mustard field of Purba Medinipur district was 17.33. The relative frequency and relative density of particular weed species ranged from 7.14% to 21.43% and 3.84% to 26.92% respectively. (Table-15)

The most relatively frequent weed species were Muhlenbergia schreberi and *Digitaria sanguinalis* with the relative frequency of 21.43%, followed by *Cynodon dactylon*, *Croton bonplandianum* and *Alternanthera philoxeroides* with the relative frequency of 14.28% and the least relative frequency was reported by *Chenopodium album* and *Argemone mexicana* with the relative frequency of 7.14%. (Fig. 32)



(**Fig. 32: -** Relative frequency of weed species in Mustard field from Purba Medinipur district.)

The most relatively dominant weed species was *Digitaria sanguinalis* (26.92%) followed by *Muhlenbergia schreberi* (23.07%) and *Cynodon dactylon* (23.07) and the least relative density was shown by *Chenopodium album* and *Argemone mexicana* with the relative frequency of 3.84%. (Fig. 33)



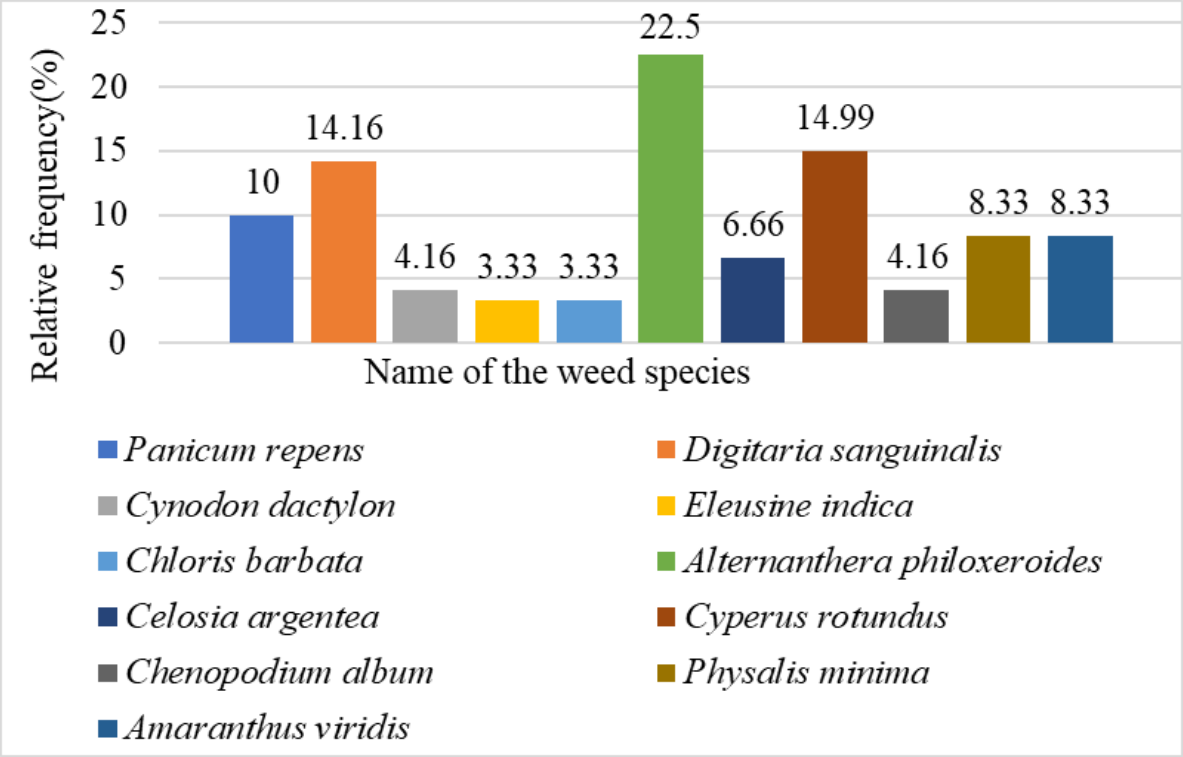
(**Fig. 33: -** Relative density of weed species in Mustard field from Purba Medinipur district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Mustard	Purba Medinipur	17.33	*Muhlenbergia schreberi*	Poaceae	100	21.43	23.07
			Digitaria sanguinalis	Poaceae	100	21.43	26.92
			Cynodon dactylon	Poaceae	66.66	14.28	23.07
			Croton bonplandianum	Euphorbiaceae	66.66	14.28	11.53
			Alternanthera philoxeroides	Amaranthaceae	66.66	14.28	11.53
			Chenopodium album	Amaranthaceae	33.33	7.14	3.84
			Argemone mexicana	Papaveraceae	33.33	7.14	3.84

(**Table 15: -** List of weeds of different Mustard field in Purba Medinipur district.)

5.5.3 Groundnut: - A total number of 11 weed species were identified from different groundnut field from different blocks of Purba Medinipur district. The most common families according to the number of represented species were Poaceae, Cyperaceae, Solanaceae and Amaranthaceae. The result showed that the absolute density of weed flora in groundnut field of Purba Medinipur district was 15. The relative frequency and relative density of particular weed species ranged from 3.33% to 22.5% and 1.85% to 34.25% respectively. (Table-16)

The most relatively frequent weed species were *Alternanthera philoxeroides* with the relative frequency of 22.5%, followed by *Cyperus rotundus* with the relative frequency of 14.99% and the least relative frequency was reported by *Eleusine indica* and *Chloris barbata* with the relative frequency of 3.33%. (Fig. 34)

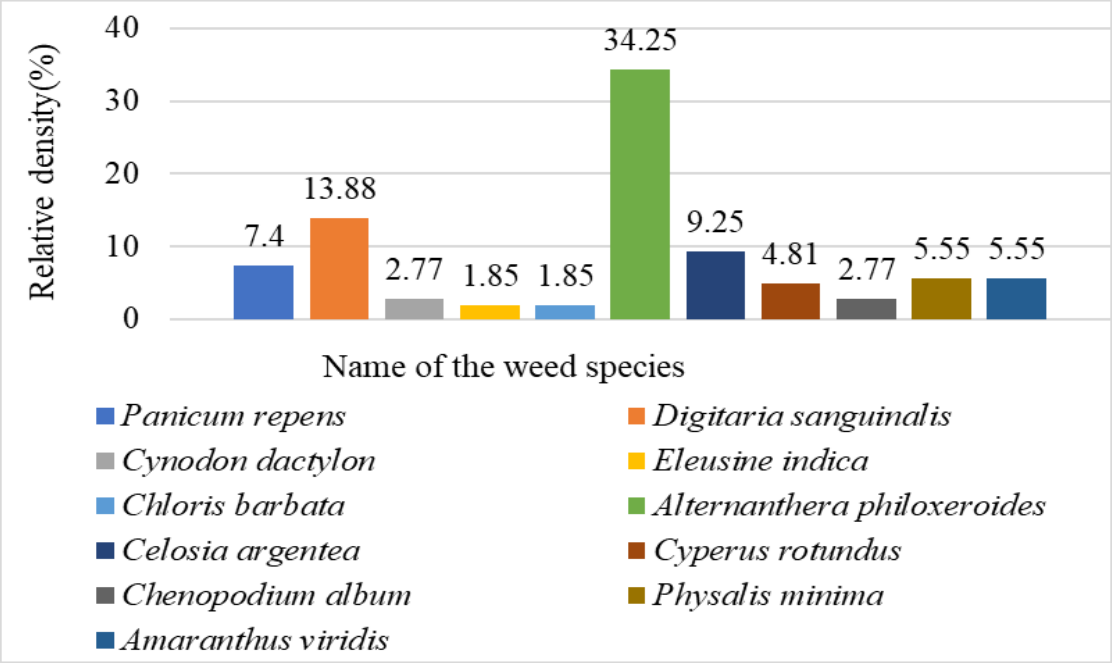


(**Fig. 34: -** Relative frequency of weed species in Groundnut field from Purba Medinipur district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Groundnut	Purba Medinipur	15	*Panicum repens*	Poaceae	50	10	7.40
			Digitaria sanguinalis	Poaceae	66.66	14.16	13.88
			Cynodon dactylon	Poaceae	16.66	4.16	2.77
			Eleusine indica	Poaceae	16.66	3.33	1.85
			Chloris barbata	Poaceae	16.66	3.33	1.85
			Alternanthera philoxeroides	Amaranthaceae	100	22.5	34.25
			Celosia argentea	Amaranthaceae	33.33	6.66	9.25
			Cyperus rotundus	Cyperaceae	66.66	14.99	4.81
			Chenopodium album	Amaranthaceae	16.66	4.16	2.77
			Physalis minima	Solanaceae	33.33	8.33	5.55
			Amaranthus viridis	Amaranthaceae	33.33	8.33	5.55

(**Table 16: -** List of weeds of different Groundnut field in Purba Medinipur district.)

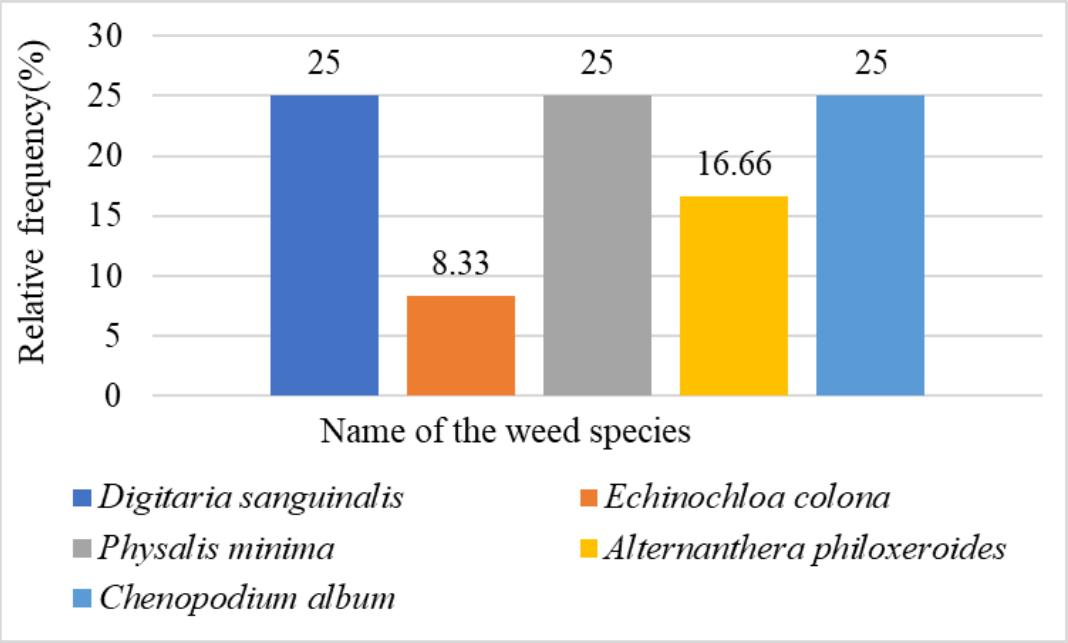
The most relatively dominant weed species was *Alternanthera philoxeroides* (34.25%) followed by *Digitaria sanguinalis* (13.88%) and the least relative density was shown by *Eleusine indica* and *Chloris barbata* with the relative frequency of 1.85%. (Fig. 35)



(**Fig. 35: -** Relative density of weed species in Groundnut field from Purba Medinipur district.)

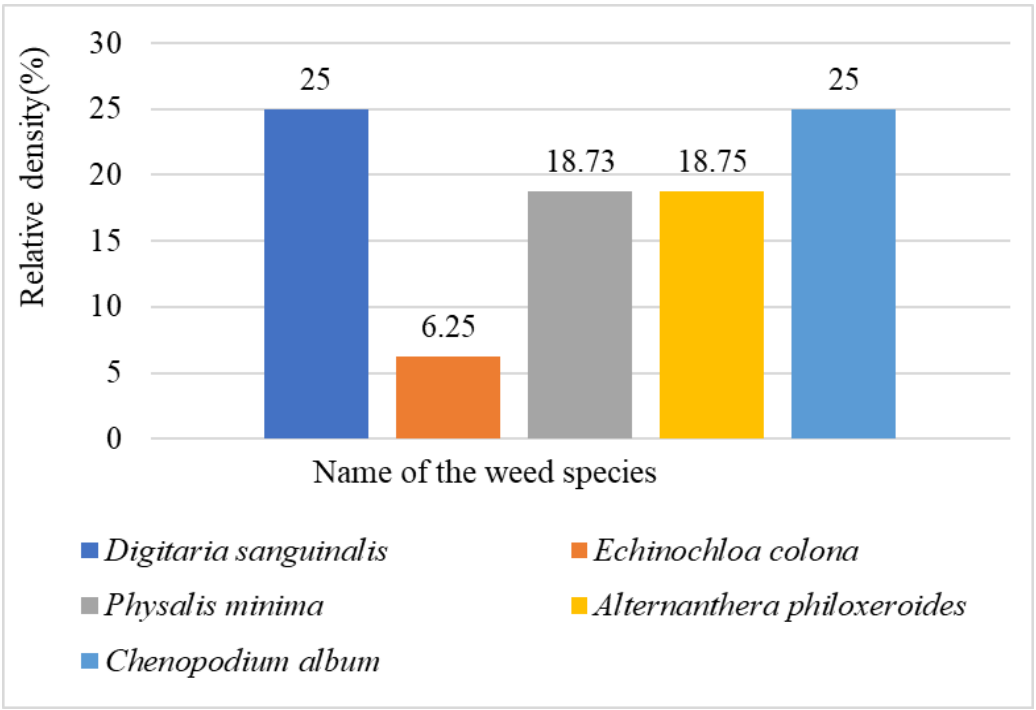
5.5.4 Potato: - A total number of 5 weed species were identified from different potato field from different blocks of Purba Medinipur district. The most common families according to the number of represented species were Poaceae, Solanaceae and Amaranthaceae. The result showed that the absolute density of weed flora in potato field of Purba Medinipur district was 10.66. The relative frequency and relative density of particular weed species ranged from 8.33% to 25% and 6.25% to 25% respectively. (Table-17)

The most relatively frequent weed species were *Digitaria sanguinalis, Physalis minima* and *Chenopodium album* with the relative frequency of 25%, followed by *Alternanthera philoxeroides* with the relative frequency of 16.66% and the least relative frequency was reported by *Echinochloa colona* with the relative frequency of 8.33%. (Fig. 36)



(**Fig. 36: -** Relative frequency of weed species in Potato field from Purba Medinipur district.)

The most relatively dominant weed species were *Digitaria sanguinalis and Chenopodium album* with the relative density of 25%, followed by *Alternanthera philoxeroides* (18.75%) and the least relative density was shown by *Echinochloa colona* with the relative frequency of 6.25%. (Fig. 37)



(**Fig. 37: -** Relative density of weed species in Potato field from Purba Medinipur district.)

Crop	District	Absolute Density (No. of weeds/ m^2)	Name of the weed species	Family	Absolute Frequency (%)	Relative Frequency (%)	Relative Density (%)
Potato	Purba Medinipur	10.66	*Digitaria sanguinalis*	Poaceae	100	25	25
			Echinochloa colona	Poaceae	33.33	8.33	6.25
			Physalis minima	Solanaceae	100	25	18.73
			Alternanthera philoxeroides	Amaranthaceae	66.66	16.66	18.75
			Chenopodium album	Amaranthaceae	100	25	25

(**Table 17: -** List of weeds of different Potato field in Purba Medinipur district.)

Chapter 6: Discussion

6. Discussion

The result of the survey work portrayed a broad picture about the dominance of different weed species in different crop field of the selected districts.

The result showed that the most relatively frequent and dominant weed species in rice field of Jhargram, Purba medinipur, pashchim medinipur, South 24-Pargans and Birbhum district of West Bengal were *Echinochloa colona, Echinochloa crus-galli, Schoenoplectiella juncoides, Alternanthera philoxeroides*. Similar result was observed from the report of a case study by Mallick & Raha, 2015. For effective control of *Echinochloa colona* the application of pendimethalin and flumioxazin can be done at suggested dose. While in rice plant the application of pendimethalin and flumioxazin treatment can cause a slight biomass reduction in compare to the non-treated control was due to a slight suppression at an early stage, though that was recovered at a later stage as there was no sign of toxicity in the plants (Mahajan et., al). *Echinochloa crusgalli* can be controlled efficiently through hand hoeing. Hand hoeing is an effective method for Controlling *Echinochloa Crusgalli* particularly on small size farms of Asia (Chin, 2001).

In mustard field *soliva anthemifolia, Muhlenbergia Schreberi, Alternanthera philoxeroides, Digitaria sanguinalis* were found as relatively dominant weed species. Similarly, this kind of weed species was reported from a field experiment by Teja & Duary, 2018. Metsulfuron and imazapyr was found most effective for controlling *Alternanthera philoxeroides*. These herbicides provide longer duration of control than glyphosate, before regrowth was observed (Hofstra & Champion, 2010).

The potato fields of the study area were dominated by the weed species like, *croton bonplandianum, Digitaria sanguinalis, Chenopodium album, Solanum nigrum*. Soren et al., 2018, also reported the similar kind of weed species from their experimental field. Ethalfluralin and trifluralin can control *Chenopodium album* efficiently when used at proper dose. Ethalfluralin can cause some crop injury when used in higher amount. The effect of pendimethalin on controlling *Chenopodium album* was very effectively described by Alebrahim et al., 2012.

Groundnut fields of the mentioned districts were dominated by *Digitaria sanguinalis, Eleusine indica, Alternanthera philoxeroides, celosia argentea, portulaca oleracea* etc. Similar weed species were reported by Shah & Pramanik, 2020 from their experimental

field. Post emergence application of quizalofopp-ethyl @ 50 g a.i. ha^{-1} along with pre-emergence application of pendimethalin @ 1.0 kg a.i. ha^{-1} showed significantly lower total weed density (52.1/m2), weed dry weight (12.1g m^{-2}) and higher weed control efficiency (91.3%) in groundnut field (Sagvekar et al., 2015).

The weed species like *Eleusine indica, Amaranthus viridis, Dactyloctenium aegyptium* have been found as relatively dominant weed species in green gram field of different districts under the study area. Application of pre-emergence application of Pendimethalin+ Imazethapyr 1 kg ha^{-1} and post-emergence application of Fluazifop-p-butyl+ Fomesafen 313 g ha^{-1} recorded the lowest total weed density, total weed dry weight along with comparatively higher weed control efficiency, and higher grain and haulm yields of green gram (Rathika et al., 2023).

Sesamum fields of South 24-Parganas district were dominated by weed species like *Eleusine indica, Alternanthera philoxeroides, physalis minima* while *Dactyloctenium aegyptium, Setaria viridis* were found dominant in chickpea field. The results revealed that pre-emergence application of alachlor 50 EC @ 0.75 kg ai ha^{-1} + Hand weeding at 30 days after sowing + Intercultivation at 45 days after sowing significantly reduced the weed density (6.53/m^2), dry weight of weeds (1.80 g m^{-2}) and weed index (16.89%) by increasing the weed control efficiency (74.24%) (Mruthul et al., 2015).

Integrated weed management with the diversified cropping system is the best possible solution to counter the associated weeds of different crop. Integrated weed management practice is the most economical way of controlling weed with the integration of chemical, biological, manual way; in association with agronomic and cultural practices (Mishra et al., 2017). The diversified cropping system also provides economical security to the farmers where there is a chance of crop failure. Adaptation of diversified cropping system among the farmers would help to control the population of crop associated annual and biennial weed species for a particular crop field which will help in minimizing yield loss. Intercropping with cover crops can reduce the weed population in crop field to an extent by suppressing their growth, also it can augment farm income by increasing total yield from the field.

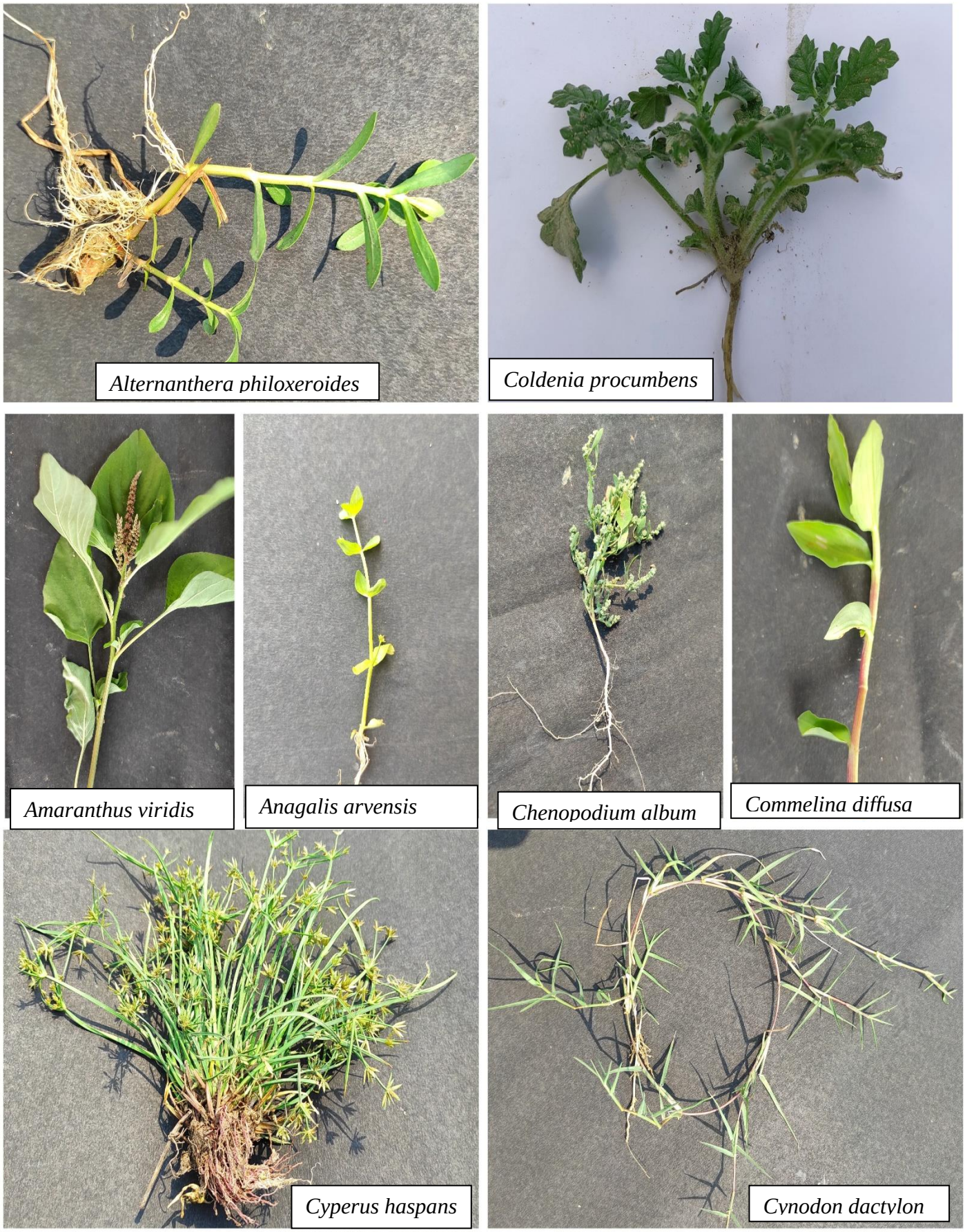


Fig. 38: - Picture of weed sample 1

Leptochloa chinensis

Digitaria sanguinalis

Croton bonplandianum

Echinochloa crusgalli

Echinochloa colona

Euphorbia hirta

Gamochaeta pensylvanica

Gnaphalium indicum

Fig. 39: - Picture of weed sample 2

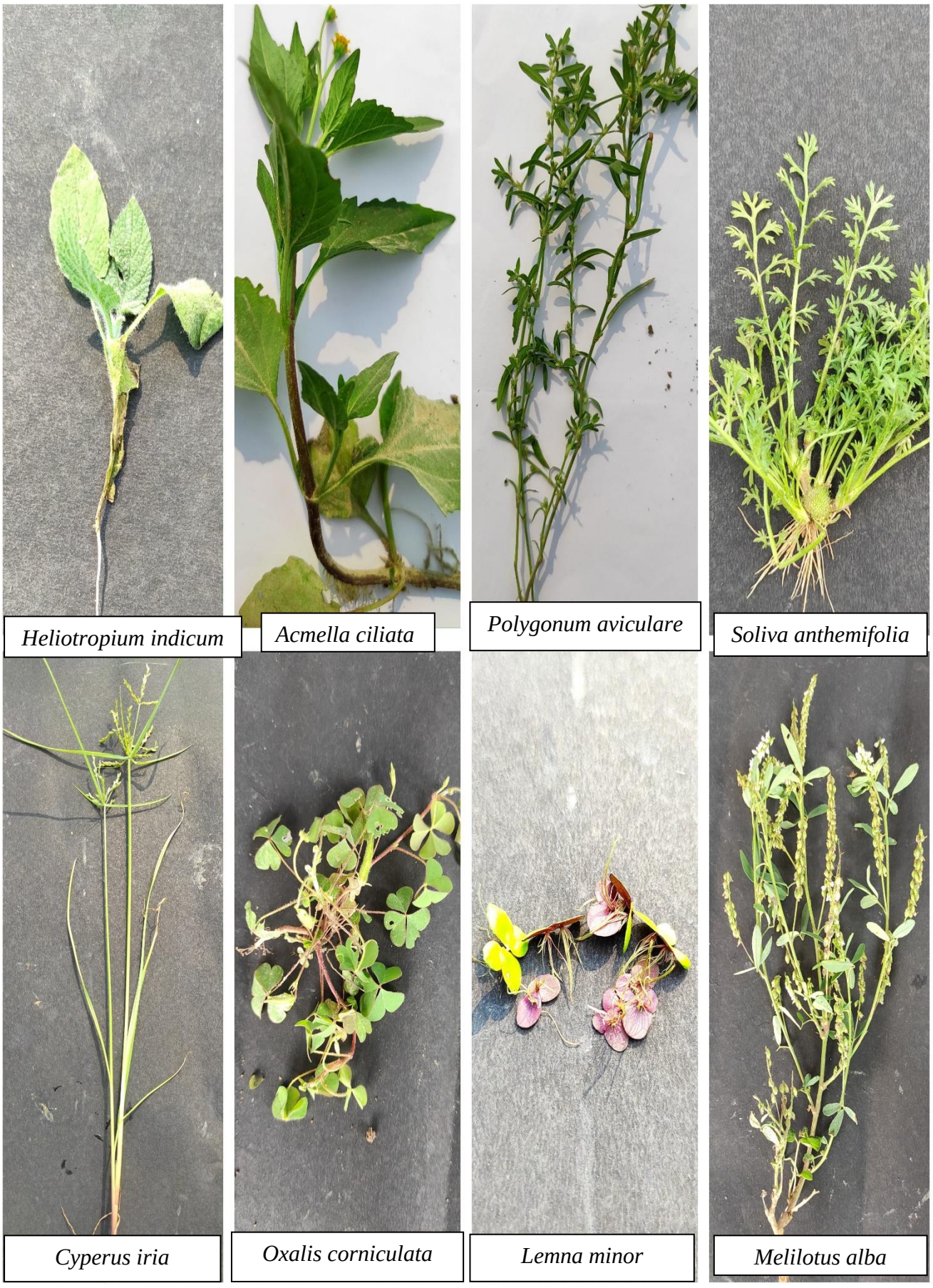


Fig. 40: - Picture of weed sample 3

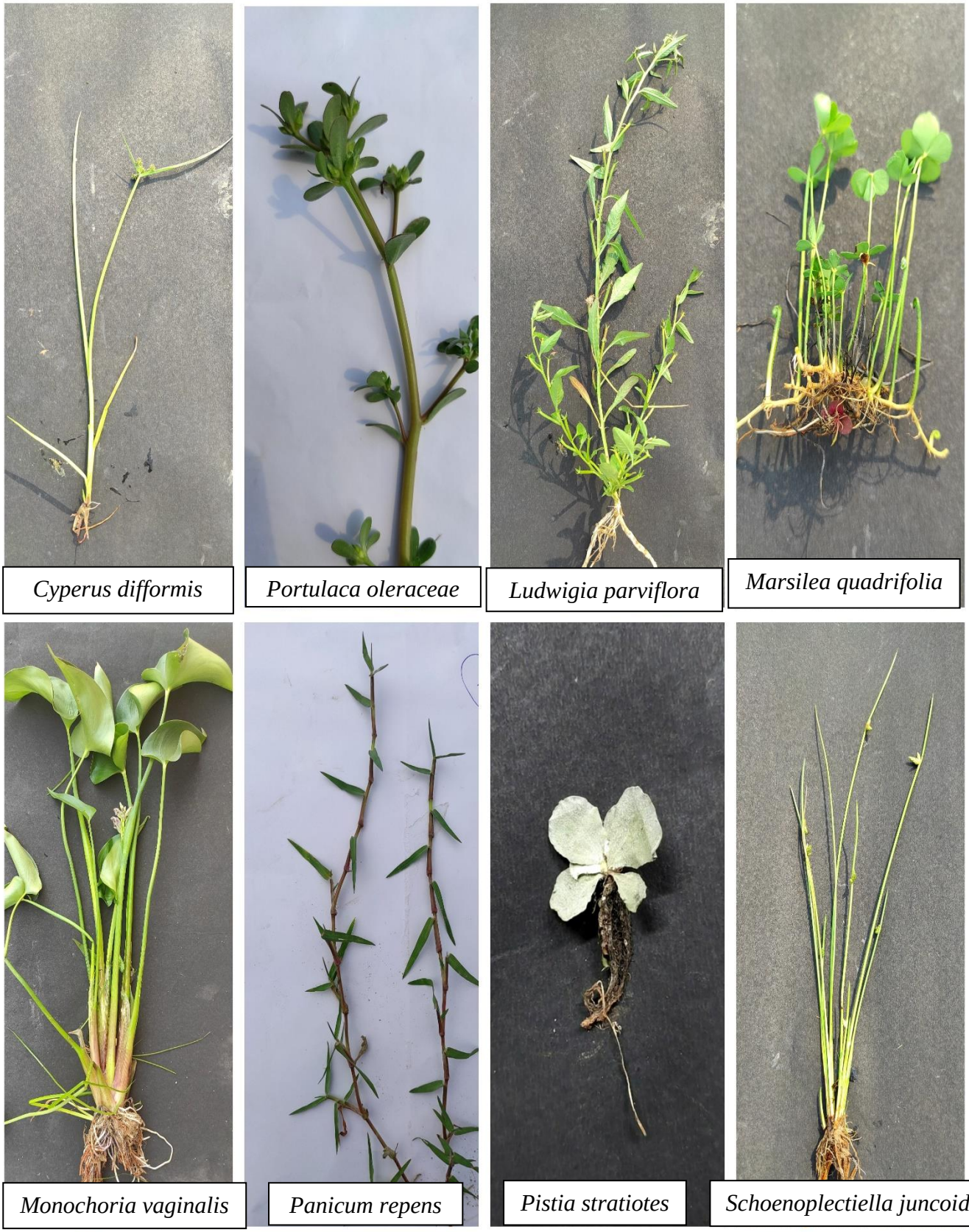


Fig. 41: - Picture of weed sample 4

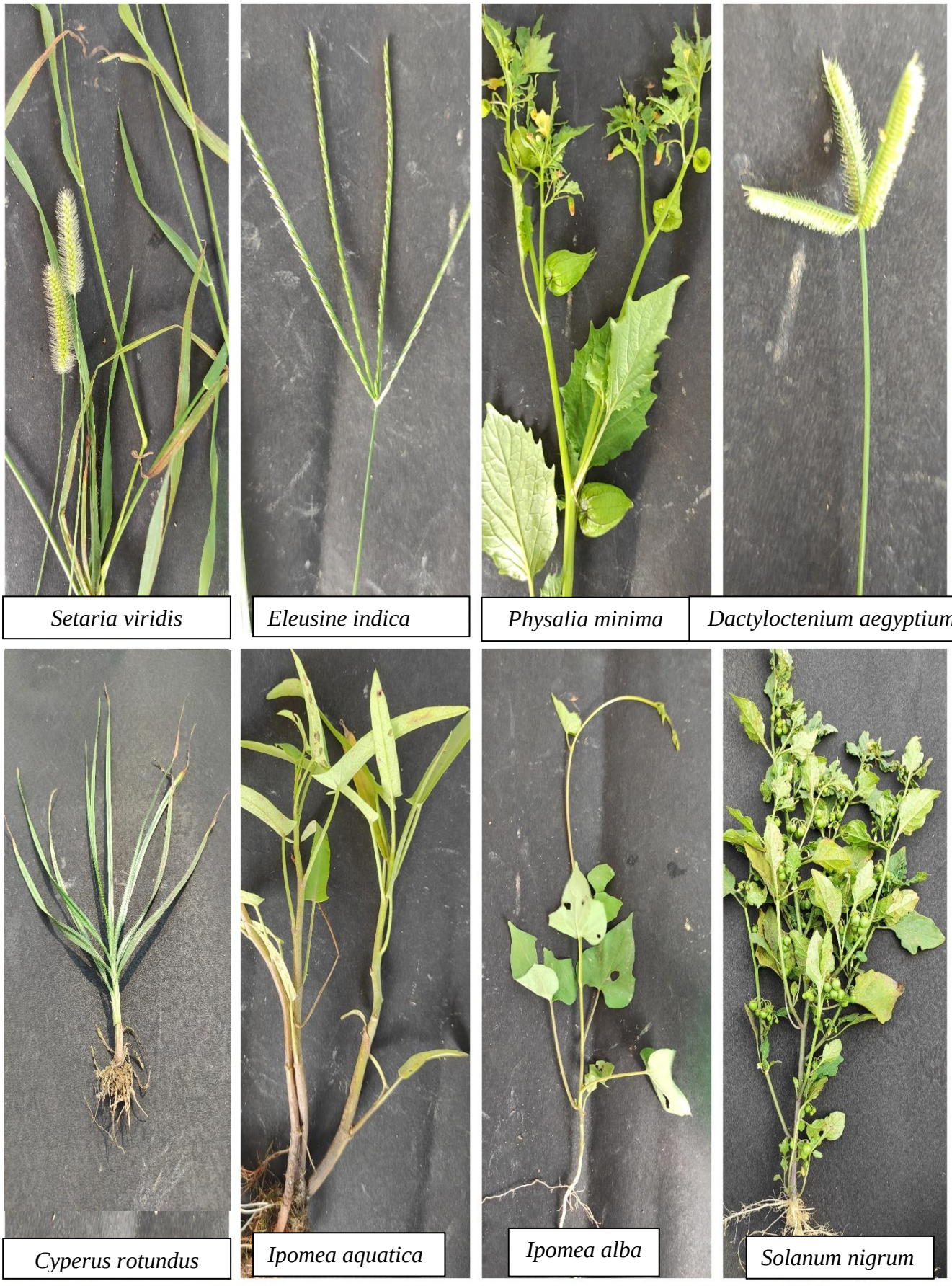


Fig. 42: - Picture of weed sample 5

Chapter 7: Conclusions

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7. Conclusions

The result obtained from the survey and analysis of the data collected from the rice, potato, mustard, groundnut, chickpea, green gram, sesamum crop field of Jhargram, Paschim Medinipur, South 24-Pargans, Birbhum and Purba Medinipur districts of West Bengal during *rabi* season of 2022-2023. The survey result displayed that the dominant and frequent crop associated weed species of the above listed districts through quantitative comparison. The most dominated weed in those above-mentioned districts was *Schoenoplectiella juncoides, Echinochloa colona, Echinochola crusgalli, Cyperus difformis, Alternanthera philoxeroides* in rice field and in potato field *Croton bonplandianum, Digitaria sanguinalis, Chenopodium album, Solanum nigrum* were more dominant. The mustard field was dominated by *Soliva anthemifoila*, *Muhlenbergia Schreberi*, *Alternanthera philoxeroides*, *Digitaria sanguinalis* and groundnut field was dominated by *Digitaria sanguinalis, Eleusine indica, Alternanthera philoxeroides, Celosia argentea, Portulaca oleracea* etc. In south 24-parganas district *Eleusine indica, Alternanthera philoxeroides*, *Physalis minima* were dominant in sesamum field and *Eleusine indica, Dactyloctenium aegyptium, Amaranthus viridis* were in greengram field while *Dactyloctenium aegyptium, Setaria viridis* were dominant in chickpea field. By identifying the weeds and analyzing its ecological success in particular crop field, the effective and economic management strategies for the weeds and best cropping pattern according to the region has been suggested.

Chapter 8: Future Scope

8. Future Scope

The survey work entitled “Characterizing of weed population and their dominance over the existing *rabi* crops in West Bengal” was carried out in five districts of southern part of West Bengal. Ecological and economical management strategies for the weed in particular crop field and suitable cropping pattern for the different region has been suggested according to the result. There is an adequate amount of possibility of research for the improvement of weed management and minimizing the yield loss is mentioned below.

- This comparative study is essential for further research and development work in respect to weed management in study area.
- More survey work will be helpful on a regular interval to identify possible problematic weed population shift and direct research towards improved and sustainable control measures.
- New experiment can be done on nutrient response and nutrient uptake by the crop associated weeds.
- Variation in particular herbicide resistance in particular weed species in different region can be studied.

CHAPTER 9: REFERENCES

9. REFERENCES

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