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Research Article

Assessment of Major Weeds for Cereals Crops in Buno Bedele and Ilu Aba Bor Zones of South-western Oromia, Ethiopia

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Abstract

Field survey was conducted to assess weeds of three major cereal crops i.e maize, sorghum, and Tef in representative districts of Ilu Aba Bora and Buno Bedele Zones of Southwestern Oromia. Key parameters such as frequency, dominance, abundance and similarity index have been analyzed for each crop and district. Generally, for most crops and districts, annual broad-leaf weeds dominated over grass, sedge and leafless type of weeds. The most dominant weed family that contained the highest number of weed species for all crops and fields assessed was *Poaceae* followed by *Asteraceae*, *Compositeae* and *Caryophyllaceae* families. In most cases, weeds of a crop were similar across the various districts as indicated by similarity index. The frequency of individual weed species in maize, sorghum, and tef fields ranged from 3.3% up to 100%, 6.7% up to 100% and 3.3% up to 100% respectively in the Buno Bedele zone and 3.3%-100% in maize, sorghum and tef respectively in Ilu Aba Bor zone while the dominance value ranged from 0.4% up to 24.7%, 0.5% up to 13.2% and 0.1% up to 14.8% respectively in Buno Bedele zone and 0.5% up to 26.3%, 0.2% up to 20.8% and 0.2 up to 25.4% in maize, sorghum and tef respectively in Ilu Aba Bor zone. The most frequent and dominant weed species were *Galinsoga parviflor, Polygonum nepalense, Bidens pachyouma, Guzotia scabra* (Vis.) Chiov., *Trifolium pretense and Datura stramonium* L. for both Maize and Sorghum; *Spergula arvensis* L., *Setaria pumila, Galinsoga parviflor, Polygonum nepalense, Cyperus esculentus* L., *Centella asiatica* L. *Trifolium pratense* and *Bidens pachyouma* for Tef crop.

Keywords

Family, Distribution, Status, Major Cereals, Weed

1. Introduction

Weed is the most underestimated pest in tropical agriculture, but influencing human activities more than other crop pests contributing towards lowering the harvestable yields [2]. The distribution and density of weeds in an arable field is the result of ecological reactions to previous management practices, soil characteristics of the site and the regional climate [4, 10]. Weeds not only reduce the crop yield, but also deteriorate the quality of farm produce that trim down the market value of the grain.

The low acreage and yield are attributed to diverse and complex abiotic and biotic factors, of which weeds often pose a serious problem. The weed flora of Ethiopia is highly

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diverse and it is composed of a wide range of perennial and annual grasses and broadleaved weeds, sedges, parasitic and invasive weed species [9]. Weeds compete with cultivated food crops for limited resources such as water, nutrients, space and light [1, 2].

Weeds infestation also encourage disease problems, serve as an alternate host for deleterious insects and diseases, slow down harvesting operation, increase the cost of production, reduce the market value of crops and increases the risk of fire in perennial crops, plantation and forest reserves [17]. Although most farmers are less concerned about the negative impact that weeds impose on their crop, study results indicate that weeds share up to 45% of the total annual losses of agricultural products [5].

Weed flora composition is strongly associated with regional climate, soil characteristics, and management methods. Previously some studies have been conducted on weed flora and their distribution in Ethiopia [8, 12], in Eastern Harerge [14], in mid-rift valley of Ethiopia and in Southwestern Ethiopia. However, surveys are commonly used to characterize weed populations in cropping systems [18]. Therefore, to develop an effective weed management program, a detailed survey is necessary to address the current weed problems in the field. In addition, survey information is entirely important in building target-oriented research programs. Hence, this study was undertaken to assess, identify and document the major cereal weeds in Buno Bedele and Ilu Aba Bora Zones.

2. Materials and Methods

2.1. Description of Study Area

The weed survey was conducted in the Ilu Aba Bora and Buno Bedele Zones of Oromia Regional state during 2020-2022 main cropping seasons. Weed Survey was conducted to assess the abundance, dominance and frequency of major cereal crops' weeds. The surveyed areas are located in altitude range of 1499 m.a.s.l.-1995 m.a.s.l.

Table 1. *Characteristic features of surveyed Cereal fields in Buno Bedele and Ilu Aba Bor Zones with their altitude, in Southwestern Oromia.*

Zone	Districts	Crops	Altitude	No. field assessed
Buno Bedele	Bedele	Maize	1857-1967	9
		Sorghum	1871-1986	9
		Tef	1873-1960	9
	Chora	Maize	1857-1978	11
		Sorghum	1949-1995	5
		Tef	1859-1957	10
	Dabo Hana	Maize	1874-1980	10
		Sorghum	1853-1913	9
		Tef	1876-1965	10
		Mean	1853-1995	82
I/A/Bor	Matu	Maize	1680-1754	10
		Sorghum	1693-1743	3
		Tef	1704-1713	5
	Bure	Maize	1499-1775	10
		Sorghum	1499-1726	10
		Mean	1499-1775	38
		Over all of mean	1499-1995	120

m.a.s.l.= meters above sea level

2.2. Field Survey

The survey was conducted in 18 Kebeles and 120 fields in the six districts of the two zones. A purposive sampling technique was applied to select Districts. Kebeles were randomly selected from each district and based on the representativeness of cereal production of the area. About 50 samples of Maize, 36 samples of Sorghum and 34 samples of Tef were examined in both zones (Table 1). Consecutive sample sites for the same crop were 3-5 km apart depending on the topography and the relative importance of the crop within each location. Weed assessment was made along the two diagonals (in an "X" pattern) of the field from five points using 1m × 1m ($1m^2$) quadrate. Frequency (F), Abundance (A), Dominancy (D) and Similarity Index (SI) were computed for each species of weeds using the method of [16]. The collected weed data were combined and summarized. In each field, weeds specie and their numbers within the quadrates were counted and recorded. Farmers were interviewed using pre-structured questionaries' to record information on farmers' practices such as management practices, variety/ies grown, preceding crop, planting date, seed rate, fertilizer type and rate, disease type observed, and herbicides use.

2.3. Data Analyses

Frequency, Abundance, Dominance and Similarity index were calculated by the following formula. The collected weed data were combined and summarized using SPSS software.

Frequency (constancy): Is the percentage of sampling plots (vegetation registrations) on which a particular weed species is found. It explains as how often a weed species occurs in the survey area. Frequency is calculated for all weed species as follows:

$$F=X/N*100$$

Where, F= frequency; X = number of occurrences of a weed species; N= sample number

The similarity index/Community index is the similarity of weed communities between different locations or crop types.

Similarity index=SI = 100*Epg/ (Epg + Epa +Epb)

Where, *SI* = Similarity index;

Epg = number of species found in both locations;

Epa = number of species only found in location I;

Epb = number of species only found in locations II

3. Result and Discussion

3.1. Maize Weeds

3.1.1. Diversity of Weeds in Maize Fields

Twenty-five species of major weeds, belonging to 17 families were identified in maize fields in Buno Bedele zone and 19 species of major weeds, belonging to 13 families were identified in maize fields in Ilu Aba Bor zone. The greater majority of weeds (21 species) were annuals whereas four species were found to be perennial in the Buno Bedele zone and 17 species were annuals and 2 species were perennials in Ilu Aba Bor zone. About 6 weed species belonged to the family of *Poaceae*; 2 species belong to *Asteracae*, 2 species to *Compositeae*, 2 species *Caryophyllaceae* and the remaining other weed species belonged to different family of weeds in Buno Bedele zone and 5 species belong to *Poaceae*; 2 species belong to *Asteracae*, 2 species *Compositeae* and the remaining other weed species belonged to different family of weeds in Ilu Aba Bor zone. These families were also reported to be economically important and common in different parts of the country [11, 13, 15]. *Asteraceae, Poaceae* and *Fabaceae* were also found to be most important in other studies in the tropics [5] (Table 2).

Table 2. *Number of weed families identified and number of species they comprise in maize fields of Buno Bedele and Ilu Aba Bor Zones.*

Family	Number of weed species	
	Buno Bedele Zone	Ilu Aba Bor Zone
Poaceae	6	5
Asteraceae	2	2
Compositeae	2	2
Caryophyllaceae	2	1
Portulacaceae	1	1
Solanaceae	1	1
Lamiaceae	1	1
Apiaceae	1	1
Polygonaceae	1	1
Convolvulaceae	1	1
Leguminosae	1	1
Commelinaceae	1	1
Plantaginaceae	1	1
Cyperaceae	1	-
Malvaceae	1	-
Rubiaceae	1	-
Acanthaceae	1	-

3.1.2. Weed Flora of Maize Fields

The result of assessments showed that, broad leaf weeds dominate over grass, leafless and sedge weed species (Table 3). Sixteen weed species (64%) were broad-leafed; seven

weed species (28%) were grass types and the remaining two weed species (8%) were found to be leafless and sedge types in Buno Bedele Zone and thirteen weed species (68.4%) were broad-leafed; five weed species (26.3%) were grass types and the remaining one weed species (5.3%) were found to be leafless types in Ilu Aba Bor Zone. The frequency of occurrence of individual weed species ranged from 3.3%-100% in both the Buno Bedele and Ilu Aba Bor zones (Table 3). Similarly, the Dominance of individual weed species ranged from 0.4%-24.7% in Buno Bedele zone and 0.5%-26.3% in Ilu Aba Bor zone. The weed species that had the highest frequency were *Galinsoga parviflor* (100%) *Polygonum nepalense* (100%), *Bidens pachyouma* (83.3%), *Guzotia scabra (Vis.) Chiov,* (80%) and *Trifolium pretense* (70%) in Buno Bedele zone (Table 3) and similarly, *Galinsoga parviflor* (100%), *Polygonum nepalense* (100%), *Bidens pachyouma* (76.7%), *Guzotia scabra (Vis.)* Chiov, (78.3%) and *Trifolium pretense* (70%) in Ilu Aba Bor zone (Table 4). Similar results were found from [11, 13, 15, 17], reported that if the specific plant species had higher frequency and dominance value, it indicate the economic importance of it.

Table 3. *Description of Frequency, Abundance, and Dominance Frequency of weed in Maize field of Buno Bedele Zone.*

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Portulaca oleracea L.	Portulacaceae	Broad leaf	Annual	13.3	0.1	0.5
Datura stramonium L.	Solanaceae	Broad leaf	Annual	66.4	2.7	10.9
Leucas martinicensis	Lamiaceae	Broad leaf	Annual	33.3	0.4	1.6
Stellaria media	Caryophyllaceae	Broad leaf	Annual	26.7	0.3	1.3
Galinsoga parviflor	Asteraceae	Broad leaf	Annual	100.0	6.2	24.7
Pennisetum clandestium	Poaceae	Grass	Perennial	33.3	0.8	3.2
Amaranthus retroflexus	Compositeae	Broad leaf	Annual	60.0	1.1	4.3
Centella asiatica L.	Apiaceae	Broad leaf	Perennial	57.8	1.9	7.5
Eleusine indica (L.) Gaertn.	Poaceae	Grass	Annual	13.3	1.0	3.9
Waltheria indica L.	Malvaceae	Broad leaf	Annual	3.3	0.2	0.8
Polygonum Nepalese	Polygonaceae	Broad leaf	Annual	100.0	5.4	21.5
Bidens pachyouma	Asteraceae	Broad leaf	Annual	83.3	4.5	17.9
Cuscuta campestris	Convolvulaceae	leafless	Annual	6.7	0.1	0.4
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual	55.6	1.9	7.7
Oplismenus hirtellus	Poaceae	Grass	Annual	8.3	0.6	2.3
Hedyotis diffusa	Rubiaceae	Grass	Annual	6.7	0.2	0.7
Snowdenia polystachya	Poaceae	Grass	Annual	23.3	0.5	2.1
Hygrophila auriculata	Acanthaceae	Broad leaf	Perennial	6.7	0.1	0.5
Plantago lanceolata L.	plantaginaceae	Broad leaf	Annual	16.7	0.4	1.6
Cyperus esculentus L.	Cyperaceae	Sedge	Perennial	43.3	1.6	6.5
Corrigiola capensis	Caryophyllaceae	Broad leaf	Annual	13.3	0.2	0.9
Trifolium pratense	Leguminosae	Broad leaf	Annual	70.0	4.3	17.1
Setaria pumila	Poaceae	Grass	Annual	20.0	0.9	3.6
Guzotia scabra (Vis.) Chiov.	Composite	Broad leaf	Annual	80.0	5.0	20.1
Rottboellia cochinchinensis	Poaceae	Grass	Annual	36.7	0.6	2.3

Table 4. Description of Frequency, Abundance and Dominance Frequency of weed in Maize field of Ilu Aba Bor Zone.

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Portulaca oleracea L.	Portulacaceae	Broad leaf	Annual	3.3	0.1	0.5
Datura stramonium L.	Solanaceae	Broad leaf	Annual	61.7	1.8	9.5
Leucas martinicensis	Lamiaceae	Broad leaf	Annual	20	0.2	0.9
Galinsoga parviflor	Asteraceae	Broad leaf	Annual	100	5.0	26.3
Pennisetum clandestium	Poaceae	Grass	Perennial	20	1.1	6.0
Amaranthus retroflexus	Compositeae	Broad leaf	Annual	45	1.9	9.7
Centella asiatica L.	Apiaceae	Broad leaf	Perennial	51.7	1.4	7.5
Polygonum Nepalense	Polygonaceae	Broad leaf	Annual	100	4.6	24.2
Bidens pachyouma	Asteraceae	Broad leaf	Annual	76.7	3.8	19.8
Cuscuta campestris	Convolvulaceae	leafless	Annual	15	0.2	0.9
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual	58.3	2.7	14.2
Oplismenus hirtellus	Poaceae	Grass	Annual	50	0.4	2.3
Snowdenia polystachya	Poaceae	Grass	Annual	41.7	0.8	3.9
Plantago lanceolata L.	Plantaginaceae	Broad leaf	Annual	10	0.7	3.7
Corrigiola capensis	Caryophyllaceae	Broad leaf	Annual	11.7	0.3	1.4
Trifolium pratense	Leguminosae	Broad leaf	Annual	70	4.2	22.3
Setaria pumila	Poaceae	Grass	Annual	33.3	1.0	5.4
Guzotia scabra (Vis.) Chiov.	Compositeae	Broad leaf	Annual	78.3	4.5	23.5
Rottboellia cochinchinensis	Poaceae	Grass	Annual	28.3	0.3	1.4

3.1.3. Weed Similarity Index

Similarity index (community index) is the similarity of plant species composition among different districts. The weed flora similarity index of Bedele to Chora and Dabo Hana, Chora to Dabo Hana, Dabo Hana to Bure and Matu to Bure districts were above 60% which means 61%-79% similar weed management method can be used to control while weed species composition was mainly dissimilar between Bedele to Matu and Bure, Chora to Matu and Bure and Dabo Hana to Matu Districts respectively (Table 5). This might be because of the variation in soil, climatic and farm practices among these locations. Similarly, [6, 3, 7] reported that weed flora of crops differs from area to area and field to field depending on environmental conditions, irrigation, fertilizer use, soil type, weed control practices and cropping sequences.

Table 5. Characteristic feature of similarity index of weed species composition in maize fields of Buno Bedele and Ilu Aba Bor Zones.

Districts	Bedele	Chora	Dabo Hana	Matu	Bure
Bedele	100	79	61	50	46
Chora		100	65	58	55
Dabo Hana			100	52.4	61
Matu				100	69
Bure					100

3.2. Sorghum Weeds

3.2.1. Diversity of Weeds in Sorghum Fields

In the surveyed sorghum fields, 26 weed species that be-

longed to 16 families were recorded of which 22 species were annuals and 4 were found to be perennials in Buno Bedele zone and 19 weed species that belonged to 12 families were recorded of which 16 species were annuals and 3 were found to be perennials in Ilu Aba Bor zone. About 61.5% of the species were broad leafed; 30.8% were grass types and 7.7% were leafless and sedge types in Buno Bedele zone and about 68.4% of the species were broad leafed; 26.3% were grass types and 5.3% were sedge types in Ilu Aba Bor zone. Seven species of the weeds belonged to family *Poaceae*; three species belonged to family *Asteraceae*; two species belonged to family *Compositeae* and Caryophyllaceae and the remaining other weed species belonged to different family of weeds in Buno Bedele zone (Table 6). Similarly, five species of the weeds belonged to family *Poaceae*; three species belonged to family *Asteraceae*; two species belonged to family *Compositeae* and the remaining other weed species belonged to different family of weeds in Ilu Aba Bor zone (Table 6). This means that 54% of the weed species recorded in sorghum fields belonged to the four families: *Poaceae, Asteraceae, Caryophyllaceae* and *Compositeae* in the Buno Bedele zone and 53% of the weed species recorded in sorghum fields belonged to the three families: *Poaceae, Asteraceae* and *Compositeae* in Ilu Aba Bor zone. These families were also reported to be economically important and common in different parts of the country [11, 13, 15]. Moreover, these families are very rich in species diversity so it is usual that they contain many plant species. *Asteraceae, Poaceae* and *Fabaceae* were also found to be most important in other studies in the tropics [5] (Table 6).

Table 6. *Number of weed families identified and number of species they comprise in Sorghum fields of Buno Bedele and Ilu Aba Bor zones.*

Family	Number of species	
	Buno Bedele Zone	Ilu Aba Bor Zone
Poaceae	7	5
Asteraceae	3	3
Compositeae	2	2
Caryophyllaceae	2	1
Cyperaceae	1	1
Solanaceae	1	1
Lamiaceae	1	1
Apiaceae	1	1
Polygonaceae	1	1
Commelinaceae	1	1
Leguminosae	1	1
Convolvulaceae	1	-
Plantaginaceae	1	-
Acanthaceae	1	-
Malvaceae	1	-
Rubiaceae	1	-
Portulacaceae	-	1

Weed flora of sorghum fields

The frequency of occurrence of individual weed species ranged from 6.7%-100% in Buno Bedele zone and 3.3%-100% in Ilu Aba Bor zone (Table 7). Similarly, the dominance occurrence of individual weed species ranged from 0.5%-13.2% in Buno Bedele zone and 0.2%-20.8% in Ilu Aba Bor zone (Table 7). Dominant weeds were those species which occurred in relatively greater number than the other species. The species that had the highest frequency 100% were *Galinsoga parviflor* and *Polygonum nepalense* in Buno Bedele zone (Table 7) and Ilu Aba Bor zone (Table 8). Similar results were found from [11, 13, 15, 17], reported that if the specific plant species had higher frequency and dominance value, it indicate the economic importance of it (Table 8).

Table 7. Description of Frequency, Abundance and Dominance Frequency of weed in Sorghum field of Buno Bedele zone.

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Datura stramonium L.	Solanaceae	Broad leaf	Annual	55.2	1.8	2.4
Bidens pilosa L.	Asteraceae	Broad leaf	Annual	25.6	0.5	0.7
Leucas martinicensis	Lamiaceae	Broad leaf	Annual	10.0	0.4	0.5
Stellaria media	Caryophyllaceae	Broad leaf	Annual	53.3	0.9	1.2
Galinsoga parviflor	Asteraceae	Broad leaf	Annual	100	9.9	13.2
Pennisetum clandestium	Poaceae	Grass	Perennial	51.1	1.8	2.4
Digitaria sanguinalis	Poaceae	Grass	Annual	22.2	1.2	1.6
Amaranthus retroflexus	Compositeae	Broad leaf	Annual	60.0	4.7	6.3
Centella asiatica L.	Apiaceae	Broad leaf	Perennial	55.6	4.2	5.6
Eleusine indica (L.) Gaertn.	Poaceae	Grass	Annual	21.1	2.1	2.9
Waltheria indica L.	Malvaceae	Broad leaf	Annual	6.7	0.6	0.8
Polygonum nepalense	Polygonaceae	Broad leaf	Annual	100	8.6	11.4
Bidens pachyouma	Asteraceae	Broad leaf	Annual	66.7	7.0	9.3
Cuscuta campestris	Convolvulaceae	leafless	Annual	6.7	0.6	0.8
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual	55.6	4.1	5.5
Oplismenus hirtellus	Poaceae	Grass	Annual	10.0	1.7	2.3
Hedyotis diffusa	Rubiaceae	Grass	Annual	11.7	1.4	1.8
Snowdenia polystachya	Poaceae	Grass	Annual	25.6	2.4	3.3
Hygrophila auriculata	Acanthaceae	Broad leaf	Perennial	11.1	0.5	0.7
Plantago lanceolata L.	Plantaginaceae	Broad leaf	Annual	18.3	1.5	2.0
Cyperus esculentus L.	Cyperaceae	Sedge	Perennial	35.6	3.9	5.2
Corrigiola capensis	Caryophyllaceae	Broad leaf	Annual	6.7	0.6	0.8
Trifolium pratense	Leguminosae	Broad leaf	Annual	63.3	7.5	10.0
Setaria pumila	Poaceae	Grass	Annual	18.9	2.5	3.4
Guzotia scabra (Vis.) Chiov.	Compositeae	Broad leaf	Annual	75.6	7.8	10.4
Rottboellia cochinchinensis	Poaceae	Grass	Annual	24.4	1.9	2.6

Table 8. Description of Frequency, Abundance and Dominance Frequency of weed in Sorghum field of Ilu Aba Bor zone.

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Portulaca oleracea L.	Portulacaceae	Broad leaf	Annual	18.3	0.8	2.2
Datura stramonium L.	Solanaceae	Broad leaf	Annual	62.8	1.0	2.9
Bidens pilosa L.	Asteraceae	Broad leaf	Annual	13.3	0.2	0.6
Leucas martinicensis	Lamiaceae	Broad leaf	Annual	3.3	0.1	0.2
Stellaria media	Caryophyllaceae	Broad leaf	Annual	10.0	0.7	2.1
Galinsoga parviflor	Asteraceae	Broad leaf	Annual	100.0	7.1	20.8

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Pennisetum clandestium	Poaceae	Grass	Perennial	60.0	1.0	3.0
Amaranthus retroflexus	Compositeae	Broad leaf	Annual	73.3	3.1	9.2
Centella asiatica L.	Apiaceae	Broad leaf	Perennial	65.0	2.4	7.0
Eleusine indica (L.) Gaertn.	Poaceae	Grass	Annual	41.7	0.5	1.4
Polygonum nepalense	Polygonaceae	Broad leaf	Annual	100.0	6.7	19.6
Bidens pachyouma	Asteraceae	Broad leaf	Annual	78.3	4.6	13.6
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual	63.3	3.1	9.0
Oplismenus hirtellus	Poaceae	Grass	Annual	43.3	1.3	3.7
Snowdenia polystachya	Poaceae	Grass	Annual	26.7	0.4	1.2
Cyperus esculentus L.	Cyperaceae	Sedge	Perennial	45.8	0.8	2.4
Trifolium pratense	Leguminosae	Broad leaf	Annual	80.0	3.4	9.9
Guzotia scabra (Vis.) Chiov.	Compositeae	Broad leaf	Annual	91.7	6.5	19.1
Rottboellia cochinchinensis	Poaceae	Grass	Annual	45.0	1.7	5.0

3.2.2. Weed Similarity Index

The weed flora similarity index of Bedele to Chora and Dabo Hana, Chora to Dabo Hana, and Matu to Bure districts were above 60% which means 76.5%-81.3% similar weed management method can be used to control while weed species composition was mainly dissimilar between Bedele to Matu and Bure, Chora to Matu and Bure and Dabo Hana to Matu and Bure Districts respectively (Table 9). This might be because of the variation in soil, climatic and farm practices among these locations. Similarly, [6, 3, 7] reported that weed flora of crop differs from area to area and field to field depending on environmental conditions, irrigation, and fertilizer use, soil type, weed control practices and cropping sequences.

Table 9. *Characteristic feature of similarity index of weed species composition in Sorghum fields of Buno Bedele and Ilu Aba Bor Zones.*

Districts	Bedele	Chora	Dabo Hana	Matu	Bure
Bedele	100	76.5	81.3	54.2	50
Chora		100	76.5	57	52
Dabo Hana			100	59.1	57
Matu				100	76.5
Bure					100

3.3. Tef Weeds

3.3.1. Diversity of Tef Weeds

Results of the study revealed that 26 species of weed that belonged to 16 families were recorded from tef fields of which 22 species were annuals and the remaining four were perennials in Buno Bedele zone (Table 10). Similarly, 23 species of weed that belonged to 14 families were recorded from tef fields of which 19 species were annuals and the remaining four were perennials in Ilu Aba Bor zone (Table 10). About six species in Buno Bedele zone and five species in Ilu Aba Bor belonged to family of *Poacea*; three species belonged to *Asteraceae*, two species belonged to the family of *Compositeae* and three species belonged to *Caryophyllaceae* families both in Buno Bedele and Ilu Aba Bor zones and the remaining other weed species belonged to different family of weeds both in Buno Bedele and Ilu Aba Bor zones (Table 10). About 69% of the species were broad-leafed; 27% were grass types and 4% were sedge types in Buno Bedele zone and about 74% of the species were broad leafed; 21.7% were grass types and 4.3% were sedge types in Ilu Aba Bor zone. The same to that weed in Maize and Sorghum 52.9% of the weed species recorded in the fields belonged to the four families: *Poaceae, Asteraceae, Caryophyllaceae* and *Compositeae* in Buno Bedele and Ilu Aba Bor zones. These families were also reported to be economically important and common in different parts of the country [11, 13, 15]. Moreover, these families are very rich in species diversity so it is usual that they contain many plant species. *Asteraceae, Poaceae* and *Fabaceae* were also found to be most important in other studies in the tropics [5] (Table 10).

Table 10. Number of weed families identified and number of species they comprise in Tef fields of Buno Bedele and Ilu Aba Bor zones.

Family	Number of species	
	Buno Bedele Zone	Ilu Aba Bor Zone
Poaceae	6	5
Asteraceae	3	3
Compositeae	2	2
Caryophyllaceae	3	3
Cyperaceae	1	1
Solanaceae	1	1
Malvaceae	1	1
Apiaceae	1	1
Polygonaceae	1	1
Commelinaceae	1	1
Leguminosae	1	1
Portulacaceae	1	1
Plantaginaceae	1	1
Acanthaceae	1	1
Lamiaceae	1	-
Rubiaceae	1	-
Convolvulaceae	1	-

Weed flora of Tef fields

Broad leaf weeds dominate over grass and sedge weed species in tef fields (Table 11). Broad leaf, grass and sedge species accounted for 69%, 27% and 4% respectively in Buno Bedele zone and 74%, 21.7% and 4.3% respectively in Ilu Aba Bor zone. The frequency occurrence of individual weed species ranged from 3.3- 100% in both Buno Bedele and Ilu Aba Bor zones (Table 11). The species that had the highest frequency 100% were *Spergula arvensis L., Galinsoga parviflor, Polygonum nepalense, Cyperus esculentus* and *Setaria pumila* followed by frequency of *Trifolium pretense* (91.1%) and *Centella asiatica L.*(82.2%) in Buno Bedele zone (Table 11). Similarly, The species that had the highest frequency 100% were *Spergula arvensis L., Galinsoga parviflor* and *Setaria pumila* followed by the frequency of *Polygonum nepalense* (91.7%), both *Cyperus esculentus L.* and *Centella asiatica L.*(86.7%) and *Trifolium pretense* (85%) in Ilu Aba Bor zone. Similar results were found from [11, 13, 15, 17], reported that if the specific plant species had higher frequency and dominance value, it indicate the economic importance of it (Table 12).

Table 11. Description of Frequency, Abundance, and Dominance of weed in Tef fields of Buno Bedele zone.

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Portulaca oleracea L.	Portulacaceae	Broad leaf	Annual	50	0.8	1.3
Datura stramonium L.	Solanaceae	Broad leaf	Annual	26.7	0.7	1
Spergula arvensis L.	Caryophyllaceae	Broad leaf	Annual	100	9.6	14.8
Bidens pilosa L.	Asteraceae	Broad leaf	Annual	10	0.6	0.9
Leucas martinicensis	Lamiaceae	Broad leaf	Annual	8.3	0.5	0.7
Stellaria media	Caryophyllaceae	Broad leaf	Annual	47.8	2.1	3.2
Galinsoga parviflor	Asteraceae	Broad leaf	Annual	100	8.7	13.4
Pennisetum clandestium	Poaceaceae	Grass	Perennial	69.3	3.9	6
Digitaria sanguinalis	Poaceaceae	Grass	Annual	23.3	0.5	0.8
Amaranthus retroflexus	Compositeae	Broad leaf	Annual	27.8	3.3	5.0
Centella asiatica L.	Apiaceae	Broad leaf	Perennial	82.2	7.5	11.5
Eleusine indica (L.) Gaertn.	Poaceaceae	Grass	Annual	16.7	0.4	0.5
Waltheria indica L.	Malvaceae	Broad leaf	Annual	3.3	0.1	0.1
Polygonum nepalense	Polygonaceae	Broad leaf	Annual	100	6.7	10.3
Bidens pachyouma	Asteraceae	Broad leaf	Annual	73.3	4.3	6.6

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual	72.2	3.8	5.8
Oplismenus hirtellus	Poaceaceae	Grass	Annual	16.7	3.3	5
Hedyotis diffusa	Rubiaceae	Grass	Annual	45	3.4	5.3
Hygrophila auriculata	Acanthaceae	Broad leaf	Perennial	5	0.4	0.7
Plantago lanceolata L.	plantaginaceae	Broad leaf	Annual	43.3	1.9	2.9
Cyperus esculentus L.	Cyperaceae	Sedge	Perennial	100	5.1	7.9
Corrigiola capensis	Caryophyllaceae	Broad leaf	Annual	50	2.4	3.7
Trifolium pratense	Leguminosae	Broad leaf	Annual	91.1	4.5	6.9
Setaria pumila	Poaceaceae	Grass	Annual	100	7.8	12
Guzotia scabra (Vis.) Chiov.	compositeae	Broad leaf	Annual	27.8	2.2	3.4
Rottboellia cochinchinensis	Poaceaceae	Grass	Annual	68.9	3.9	6.0

Table 12. *Description of Frequency, Abundance and Dominance of weed in Tef fields of Ilu Aba Bor zone.*

Botanical Name	Family	Category	Life Cycle	Frequency	Abundance	Dominance
Portulaca oleracea L.	Portulacaceae	Broad leaf	Annual	56.7	1.3	3.2
Datura stramonium L.	Solanaceae	Broad leaf	Annual	46.7	0.8	2.0
Spergula arvensis L.	Caryophyllaceae	Broad leaf	Annual	100.0	9.9	25.4
Bidens pilosa L.	Asteraceae	Broad leaf	Annual	11.7	0.3	0.8
Stellaria media	Caryophyllaceae	Broad leaf	Annual	10.0	1.8	4.5
Galinsoga parviflor	Asteraceae	Broad leaf	Annual	100.0	9.3	23.8
Pennisetum clandestium	Poaceaceae	Grass	Perennial	70.0	3.1	7.8
Digitaria sanguinalis	Poaceaceae	Grass	Annual	10.0	0.2	0.5
Amaranthus retroflexus	Compositeae	Broad leaf	Annual	65.0	3.5	8.9
Centella asiatica L.	Apiaceae	Broad leaf	Perennial	86.7	5.4	13.9
Eleusine indica (L.) Gaertn.	Poaceaceae	Grass	Annual	16.7	0.3	0.7
Waltheria indica L.	Malvaceae	Broad leaf	Annual	3.3	0.1	0.2
Polygonum nepalense	Polygonaceae	Broad leaf	Annual	91.7	5.1	13.2
Bidens pachyouma	Asteraceae	Broad leaf	Annual	75.5	3.7	9.4
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual	68.3	3.1	8.0
Hygrophila auriculata	Acanthaceae	Broad leaf	Perennial	6.7	0.1	0.2
Plantago lanceolata L.	plantaginaceae	Broad leaf	Annual	65.0	1.0	2.6
Cyperus esculentus L.	Cyperaceae	Sedge	Perennial	86.7	6.1	15.6
Corrigiola capensis	Caryophyllaceae	Broad leaf	Annual	56.7	0.7	1.8
Trifolium pratense	Leguminosae	Broad leaf	Annual	85.0	6.0	15.3
Setaria pumila	Poaceaceae	Grass	Annual	100.0	4.7	12.1
Guzotia scabra (Vis.) Chiov.	Compositeae	Broad leaf	Annual	13.3	2.2	5.6
Rottboellia cochinchinensis	Poaceaceae	Grass	Annual	55.0	1.5	3.8

3.3.2. Weed Similarity Index

The weed flora similarity index of Bedele to Chora, Dabo Hana and Bure, Chora to Dabo Hana and Matu, Dabo Hana to Matu and Bure and Matu to Bure districts were above 60% which means 62.5%-83.3% similar weed management method can be used to control while weed species composition was mainly dissimilar between Bedele to Matu and Chora to Bure Districts with similarity index of 56% and 58% (Table 13). This might be because of the variation in soil, climatic, and farm practices among these locations. Similarly, [6, 3, 7], reported that weed flora of crop differs from area to area and field to field depending on environmental conditions, irrigation, fertilizer use, soil type, weed control practices, and cropping sequences.

Table 13. *Characteristic feature of similarity index of weed species composition in Tef fields of Buno Bedele and Ilu Aba Bor zones.*

Districts	Bedele	Chora	Dabo Hana	Matu	Bure
Bedele	100	75	62.5	56	62.5
Chora		100	75	65.2	58
Dabo Hana			100	83.3	65.2
Matu				100	71.4
Bure					100

4. Conclusion and Recommendation

Weeds are constant components of agro-ecosystems that have harmful effect on crop quality and quantity. They are contributing to production cost increasing through its direct labour consumption and indirectly by harboring insect and disease pests for which huge expense on pesticide. All weeds are not equally problematic in agriculture. Some weeds in addition to their ecological benefit they provide medicinal, food and insecticidal uses. Farmers clearly know which weed specie highly challenging their crop production. The disjointed land holding of the area is also another obstacle to effective weed control practice. Based on either the crop requirement or the interest of the producer, when one farmer field is under production the other neighboring farmer remains uncontrolled. At that time weed seeds coming from the neighboring fields are the most significant obstacle to effective weed control. As a result of the weak weed management; the existing practice is found encouraging the ever increasing of weed offensive. No one was start clearing his idle field for the purpose of weed control. All were observed starting weed clearing only when the land has been required for cultivation. Farmers of the study area were familiar with cultivating the same crop year after year or with a short period of rotation. This type of practice favors the offensive of the field by some weed species as a result of the cultural practice and herbicides used for that crop.

Maize, Sorghum and Tef was the dominant crops cultivated in the field surveyed and weeds of the major cereal crops were assessed with regard to important parameters. In the study, different weed families and weed species were identified for each crop. The most dominant family according to frequency and number of weed species were *Poaceace, Asteraceae*, *Caryophyllaceae* and *Compositeae* families. The frequency and dominance value ranges of individual weed species of maize, sorghum and tef fields were assessed and summarized. The most frequent and dominant weed species were *Galinsoga parviflor, Polygonum nepalense, Bidens pachyouma, Trifolium pretense,* and *Guzotia scabra (Vis.) Chiov*, for maize in both zones, *Galinsoga parviflor, Amaranthus retroflexus, Polygonum nepalense, Bidens pachyouma, Trifolium pretense,* and *Guzotia scabra (Vis.) Chiov.,* for Sorghum in both zones and *Spergula arvensis L., Galinsoga parviflor, Centella asiatica L., Polygonum nepalense, Cyperus esculentus L., Trifolium pretense* and *Setaria pumila* for Tef crop in both zones. Therefore, the way to use the proper crop rotation system and change in weed management practices should be developed to combat the ever worsening of the problem. To solve the dispute on weed management practices, an integrated crop protection system should be to the needs of the resource-poor farmer, which weeds are managed in such a way their biodiversity is maintained and the more useful species retained within the field. As the weeds recorded have been described in detail, this information can be a useful tool for weed management research and strategies to pursue in the future for the various crops and districts.

Generally, Weed control is an important aspect of crop production, as weeds can compete with crops for resources, reduces yield and quality, and harbor pests and diseases. Weed control requires a combination of cultural, mechanical, biological, and chemical methods, as well as an integrated approach that involves different stakeholders. Here is a summary of the role of each stakeholder in weed control:

Farmers: Farmers are the primary actors in weed control, as they have to implement the appropriate practices and technologies on their farms. Farmers need to adopt preventive measures, such as using clean seeds, practicing crop rotation, and maintaining soil health, to reduce weed infestation. Farmers also need to monitor and identify the weeds on their fields, and apply suitable control methods, such as hand weeding, hoeing, mulching, cover cropping, intercropping, mowing, grazing, herbicides, or biological agents. Farmers need to evaluate the effectiveness and cost-benefit of the weed control methods and adjust them according to the changing conditions and needs.

Researchers: Researchers are the source of knowledge and innovation in weed control, as they conduct scientific studies and experiments on the biology, ecology, and management of weeds. Researchers need to develop and test new varieties,

technologies, and practices that can improve the resistance and tolerance of crops to weeds, as well as reduce the reliance on herbicides and other harmful inputs. Researchers need to communicate and disseminate their findings and recommendations to the farmers and other stakeholders, and solicit their feedback and input for further research.

Government: The government is the policy maker and regulator in weed control, as it creates and implements the laws, rules, and standards that govern the use and management of weeds and weed control methods. Government needs to provide the legal framework and incentives for the promotion and adoption of sustainable and effective weed control practices, such as integrated weed management, organic farming, and conservation agriculture. The government also needs to provide the infrastructure and support for the research and extension activities, as well as ensuring the food security and safety of the public.

Agricultural office: Agricultural officer is the technical adviser and supervisor in weed control, as he or she provides the guidance and assistance to the farmers on how to implement the best weed control practices and technologies. Agricultural officer needs to monitor and inspect the crop and weed conditions on the farms, diagnose and treat the weed problems, and enforce the relevant regulations and standards. Agricultural officer also needs to collect and analyze the data and information on the weed situation and the weed control methods and report them to the researchers and the government.

Agricultural extension: Agricultural extension is the facilitator and educator in weed control, as it bridges the gap between the research and the farmers, and transfers the knowledge and innovation from the former to the latter. Agricultural extension needs to provide training, education, and advisory services to the farmers on how to adopt and apply the best weed control practices and technologies, as well as how to solve the weed challenges and issues. Agricultural extension also needs to create and maintain the platforms and networks for the interaction and collaboration among the farmers and other stakeholders, and encourage their participation and empowerment in weed control.

Abbreviations

OARI	Oromia Agricultural Research Institute
BeARC	Bedele Agricultural Research Center
m.a.s.l	Meters Above Sea Level

Author Contributions

Takele Kusa: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Software, Supervision, Visualization, Writing – original draft, Writing – review & editing

Bati Dube: Conceptualization, Methodology, Visualization

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Conflicts of Interest

The authors declare no conflicts of interest.

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Research Field

Takele Kusa: Bedele, Chora, Dabo Hana, Matu, Bure
Bati Dube: Bedele, Chora, Dabo Hana, Matu, Bure