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Research Article

Survey on Weed Flora Composition at Irrigated Maize Production Area of Gode and Kelafo Districts, Shebele Zone, Ethiopia

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Abstract

Maize is the most highly distributed cereal in the World and it is multipurpose crop (used as human food, animals and poultry feed, and in industrial products. In spite of the huge importance of maize, its productivity is quite low (the yield of maize obtained in Ethiopia is far below expectation) due to numerous factors which include weed infestation. Weed is one the most important yield limiting factor. The present study was initiated to determine the weed flora, prevalence, distribution and frequency of weed in the surveyed crop fields. The Survey was conducted at irrigated maize production area of Gode and Kelafo districts, Shebelle zone, Ethiopia, during 2022 cropping seasons. The districts were purposefully selected based on cropping system where the maize is major crop. The assessment was done using weed counting for important points related to weed and quadrate with a size of 1×1 m was used. The weed survey conducted at the flowering stage of the crop and the data was analyzed via quantitative measures like weed frequency, field uniformity, weed density, weed dominance, and weed abundance. The result showed a total of twenty seven weed species that were collected and recorded in 15 families. From the 15 families Asteraceae family had the highest number of weed species followed by Chenopodiaceae and Gramineae were by far the richest weed species and accounted together (48.14 %) of the entire flora of the study area. 27 different weed species including 23 annuals, 1 binnial and 3 perennials which comprised of 20 broad leaf weeds, 4 types of grass, and 3 sedges by habitat were identified in gode and kelafo maize growing sites of somale regione. ethiopia. The large majority of from 27 weed species were broad leaved weeds. The highest weed frequency value (100%), field uniformity (66), weed dominance (10.43%) and weed density (9.17 plants/m2) was recorded by Xanthium strumarium. The most frequent, abundant and dominant weed species in Gode and Kelafo districts, Shebele zone, Somali region in Eastern Ethiopia were Xanthium strumarium, Tussilago farfara, Cyperus assimilis, Cyperus esculentus and Avena fatua. Therefore, maize growers should be used sound and sustainable weed management practices including cultural, chemical, and integrated weed management approaches, and further weed management studies should be conducted. Similarity indices of weed communities in different locations were also determined to be >60% across all locations sampled.

Keywords: Dominance, Flora composition, Frequency, Maize, Weed species

INTRODUCTION

Maize *(Zea mays L.)* is belongs to the family Poaceae and is an annual cross pollinated, determinate and having C4 carbon fixation pathway (Khan et al., 2012). Maize is a multipurpose crop (used as human food, animal's and poultry feed, and in industrial products) (Bibi et al., 2010). It is also known as corn in the Americas, is one of the most important cereal crops. Among other cereals, corn has the highest genetic yield potential; therefore, it is known as "queen of cereals."

The production of yellow corn predominates in the USA, Brazil, and China. However, white corn is preferred in Africa, Central America, and the northern part of South America (Rooney et al., 2004).

Maize is the most versatile crop with wider adaptability to varied agro ecological regions and diverse growing seasons. Besides serving as human food and animal feed, the importance of this crop also lies in its wide industrial applications (Wilkes, 2004). Corn oil is used in margarine, corn syrup sweeteners in marmalade, and corn syrup solids in instant non-dairy coffee creamer. In addition, corn is fed to cows, chickens, and pigs, which produce milk, eggs, and bacon, respectively. Furthermore, corn finds application in a candy bar, a beer or bourbon whisky, a hamburger, industrial chemicals, ethanol in gasoline, plastics, and in the paper sizing of a glossy magazine.

Responding to its multiple uses, the demand for corn is constantly increasing in the global market. Now it is the highest produced staple cereal followed by wheat and rice in the world with production of 1033.74 million metric tons from 197 million ha. Globally, corn is grown on more than 175 million ha across 166 countries with a production of around 880 million tones. The top six corn-producing countries are the USA, China, Brazil, India, Mexico, and Argentina. The USA is producing about 30% of the total corn produced in the world. In addition, the USA is the largest exporter of corn to several destinations in the world (Anonymous, 2013).

Maize is also a leading commercial crop of great value. The crop is also widely considered the greatest potential among food crops for attaining food security in the savanna zone of West and Central Africa (Kamara, 2001). It provides staple food to large number of human population in the world. In the developing countries, maize is a major source of income to many farmers (Tagne, 2008).

The area and production under maize in the world in 2013–2014 was 177 m ha with 967 Mt. productions and contributed almost 5% of the world's dietary energy supply (Akbar, 2019). Currently, more maize is produced annually than any other grain and is the most important cereal crop in sub-Saharan Africa and Latin America. Specifically, in sub-Saharan Africa, more and more land is used for maize production. From 2007 to 2017, the area on which maize is grown in sub-Saharan Africa has increased by almost 60%.

United States of America, China, Brazil and Mexico are the leading producing countries in the world with an average of more than 4 t/ha, contributing to about 563 million tonnes of the global total production of 717 million tonnes/year (Ranum et al., 2014). In SSA, average maize yield is lagging at about 2 t/ha, resulting into over 20% of the annual requirement being met through imports (ASARECA, 2014; VIB, 2017). Leading maize producers in Africa include South Africa, Nigeria, Ethiopia, Tanzania and Egypt (Ramirez-cabral et al., 2017).

Maize is the second most widely cultivated crop in Ethiopia and is grown under diverse agro-ecologies and socioeconomic conditions (Tsedeke et al., 2017). Its production is a vital component of food security and livelihoods among smallholder farming societies in Ethiopia. The majority of smallholder farmers grow maize principally for survival purposes. Maize is the most extensively grown crop from lowland to highland agro-ecologies in Ethiopia. Among cereal crops, maize accounts for the largest donated in the country's crop production and is grown more than any other crop by farmers. Between 2006 and 2017, the national average yield was 2.6 tons/ha, which is higher than the sub-Saharan African average of 1.98 tons/ha. In sub-Saharan Africa, global statistics show that more and more land is being used for small-scale maize production to congregate future food demands (Romy, 2020). From 2007 to 2017, the area on which maize is grown in sub-Saharan Africa has increased by almost 60%. Ethiopia is the only country in Sub-Saharan Africa that has shown substantial advancement in maize productivity and input use.

Maize is the most highly distributed cereal in the World used for human and animal feeds as well industrial purposes. The demand for maize is always higher than what is being produced in the country. It is an important cereal crop with a wider range of uses than other cereals. Because of diverse uses including human consumption, livestock feed formulation, pharmaceutical, textile industries and biofuel production its demand increasing day by day.

In spite of the huge importance of maize, its productivity is quite low (the yield of maize obtained in Ethiopia is far below expectation) due to numerous factors which include weed infestation, low soil fertility, unavailability of labour and environmental variables. Excluding environmental variables, yield losses in corn are caused mainly by competition with weeds. Weed is one the most important yield limiting factor. Their effects could be quite variable, but the most common is competition for available resources which leads to the drastic reduction in yield. Weeds not only decrease crop yield but also harbor insects, pests and diseases. In some cases, they serve as an alternate host for these pests.

Weed interference is a severe problem in corn, especially in the early part of the growing season, due to slow early growth rate and wide row spacing. Weeds compete with the corn plants for resources such as light, nutrients, space, and moisture that influence the morphology and phenology of crop, reduce the yield, make harvesting difficult, and mar the quality of grains.

The gradual worsening of crop pests (disease, insect and weed) is becoming the major bottlenecks of maize production and productivity. Previously some studies have been conducted on weed flora and their distribution in Ethiopia mid-rift-valley of Ethiopia, and in Southwestern Ethiopia. But, studies on weed identification, distribution, abundance and weed flora of maize is limited in the past in Shebelle zone, Gode and Kelafo districts eastern part of Ethiopia. Therefore; the present study is initiated to determine the weed flora, prevalence, distribution and categorized based on their importance, invasion trend of each weed species, factors supporting weed invasion and the contribution of weeds which so far got insignificant attention. Maynard and Hochmuth (2007) indicated that accurate identification of the particular weed species is the primary step to control the problems weed impose on agriculture. In addition identification of the existing weed flora helps to manage the balance between crop and non-crop vegetation and then maintain the natural enemies of crop pests. Maximum yields could not be obtained without controlling weeds. Developing a suitable integrated weed management system requires the precise study of weeds and their interference with crops. The critical weed crop competition period is a key component of an integrated weed management system. This period varied considerably with the nature and status of crop, weed flora composition, extent of weed infestation and the prevailing environment. This study will be helpful for farmers to have the knowledge about maize weed flora, and choose the better weed management option by knowing the distribution, abundance and type of weed present in the area. Therefore the study will be conducted in order to pave the way for proper weed management decisions in future. Therefore; this study aims to determine the weed composition in the field of irrigated maize production area at Shebelle zone, Gode and Kelafo districts eastern part of Ethiopia.

MATERIALS AND METHODS

Survey study methodology

Description of the study area

The weed survey will be conducted during September 2021 in irrigation at the flowering stage of the crop to assess the distribution of weed species in maize crop fields in two districts, namely Gode and Kelafo district in Shebelle zone of Somali region eastern parts of Ethiopia.

Godey is located in the Shebelle Zone; the city has a latitude and longitude of 5°57′N 43°27′E with average elevation 358 meters above sea level (m.a.s.l.). The average annual temperature in Godey is 28.8°C or 83.8°F, and virtually every afternoon exceeds 32°C or 89.6°F, while mornings seldom fall below 20°C or 68°F. The major crops grown in the district include cereal crops (maize, wheat and sorghum), vegetables (onion, tomato, cabbage, peppers and carrot) and fruits (mango, guava, papaya, banana and lemon).

Kelafo has a latitude and longitude of 5°35′20′′N 44°12′20′′E with average elevation 233 meters above sea level (m.a.s.l.). The major crops grown in the Kelafo district include maize, wheat, sorghum, vegetables and fruits (Livestock, Crop and Rural Development Bureau. 2013). Maize is the first dominant crop grown on those districts (Livestock, Crop and Rural Development Bureau, 2013).

Sampling technique and procedures

The districts were purposefully selected based on cropping system where the maize is major crop. In each of the maize field, quadrat (1m*1m) was placed randomly following a W-pattern, and from each arm one sample was taken. The data was collected during the peak period of weed growth at flowering stages of maize. All weed species there were uprooted, cleaned, and separately placed in plastic bags. There were five sampling sites per area. After completing the weed collection from the crop fields the specimens were sorted, identified and classified to their family by using the 'Flora of British India' by Hooker 'Flora of Andhra Pradesh' by Pullaiah and Chennaiah, Weed Identification and Control Guide.

DATA COLLECTION

Data on weeds

Weed composition: The name of weed species along with their corresponding family will be recorded in each field in the study area.

Weed density (WDm2): The number of each individual weed species will be counted in each quadrat of the surveyed fields of the districts. To obtain the density of each weed species in their respective districts, their density in each quadrat will be summed and divided by the total number of quadrats containing the species.

Weed Density (WDm2) =(Total number of individual weed species in all qudrants)/(Total number of qudrants)

Species richness (SR): The number of species present in the sampling unit will be recorded and expressed per m2 basis to express the number of species in each field.

Frequency percentage (%): The frequency of weed species will be calculated by dividing the number of fields that contain the targeted species to the total number of surveyed fields (Tamado and Milberg, 2000).

$F = X * 100 / N$, Where, F= frequency; X = number of occurrences of a weed species; N= sample number

Weed abundance: It can be calculated by the following formula.

Weed abundance (WA) = $\sum W/N$ Where, A = abundance; W = number of individual species/ sample; N = sample number

Weed dominance (D): Abundance of an individual weed species in relation to total weed abundance.

$D = A*100/\sum A$ Where, D = dominance; A = abundance; $\sum A$ = total abundance (of all species)

Weed cover (WC): Braun-Blanquet method is used to determine ground cover by the weed species. In this method different scale number are given depending upon the area of coverage by the weed species:

Field uniformity (%): It will be calculated on the basis of number of quadrats placed in each field/district in the study area. To calculate the field uniformity of individual species; the frequency of individual species in the respective district will be counted and divided by the total number of quadrats placed in the district and will be changed to percentage basis.

Weed infestation: It refers to the percentage of weeds in the composite population of weed and crop plants. (+++ - High infestation (60 – 90% occurrence), ++ - moderate infestation (30 – 59% occurrence) and + -low infestation (1-29% occurrence).

Similarity indices: Jaccard coefficient of similarity index was used to compare the weed composition of the districts. Jaccard coefficient of similarity was calculated as; Jc = a/(a+b+c);

Where, a = Number of species found in both locations, b = Number of species found only in location 1, c = Number of species found only in location 2.

Data analysis

The data on weed species were summarized using the formula described above.

RESULTS AND DISCUSSIONS

Weed composition

A total of twenty-seven weed species were collected and identified from the surveyed three kebeles of selected districts of gode and kelafo Zones from farmer irrigated maize fields during 2022 cropping seasons (Table 2). 27 different weed species including 23 annuals, 1 binnial and 3 perennials which comprised of 20 broad leaf weeds, 4 types of grass, and 3 sedges were identified in gode and kelafo maize growing fields of somale regione. The large majority of from 27 weed species were broad leaved weeds (Table 2). Twenty-seven weed species found infesting the surveyed fields belonged to fifteen families. The weed flora composition present in the surveyed fields is presented in table 2.

The weed species represented 15 families in the surveyed fields are (Asteraceae (7), Chenopodiaceae (3), Gramineae (3), Leguminosae (1), Cyperaceae (2), convolvulaceae (2), Boraginaceae (1), Phyllanthaceae (1), Polygonaceae (1), Papaveraceae (1), solanaceae (1), caryophyllaceae (1), Cleomaceae (1), Anthericaceae (1), capparidaceae (1)) (Table 2).

Table 1. Weed cover scale and description.

Scale / Class	Description
0	Sparsely present
1	Plentiful but with small coverage
2	Numerous or covering 1/2 of the area
3	Number of weed species covering ¼ to ½ of the area
4	Number of weed species covering ½ to ¾ of the area
5	Weed species covering more than ¾ of the area

Table 2. Weed flora composition recorded in irrigated maize field at the surveyed sites of gode and kelafo, shebele zone in somale regione in 2022 cropping season.

Weed species	Family	Life form (category)
Argemone Mexicana	Papaveraceae	Broad leaved (annual)
Atriplex patula	Chenopodiaceae	Broad leaved (annual)
Avena fatua	Gramineae	Grassy (annual)
Chenopodium album	Chenopodiaceae	Broad leaved (annual)
Chenopodium opulifolium	Chenopodiaceae	Broad leaved (annual)
Chlorophytum comosun	Anthericaceae	Grassy (perennial)
Chrysanthemum segetum	Asteraceae	Broad leaved (annual)
Circium vulgare	Asteraceae	Spiny Broad leaved (binnial)
Cleome rutidosperma	Cleomaceae	Broad leaved (annual)
convolvulus arvensis	convolvulaceae	Broad leaved (annual)
Cyperus assimilis	Cyperaceae	Sedge (annual
Cyperus esculentus	Cyperaceae	Sedge (annual
Datura stramonium	solanaceae	Broad leaved (annual)
Digitaria abyssinica	Gramineae	Grassy (perennial)
Eriocloa fatmensis	Gramineae	Grassy (annual)
Guizotia scabra	Asteraceae	Broad leaved (annual)
Gynandropsis gynandra	capparidaceae	Broad leaved (annual)
Heliotropium cinerascens	Boraginaceae	Broad leaved (annual)
Ipomoea eriocarpa	convolvulaceae	Broad leaved (annual)
Lactuca virosa	Asteraceae	Broad leaved (annual)
Medicago polymorpha	Leguminosae	Broad leaved (annual)
Phyllanthus niruri	Phyllanthaceae	Broad leaved (annual)
Polygonum nepalense	Polygonaceae	Broad leaved (annual)
Spilanthes mauritiana	Asteraceae	Broad leaved (annual)
Stellaria media	caryophyllaceae	Sedge (annual
Tussilago farfara	Asteraceae	Broad leaved (perennial)
Xanthium strumarium	Asteraceae	Broad leaved (annual)

The highest number of weed species (7) was collected from both districts during survey period and the lowest number of weed species (1) was collected from both district. From the 15 families Asteraceae family had the highest number of weed species followed by Chenopodiaceae and Gramineae (Table 3). The majority of species identified were from the

Asteraceae family (7 species). Similar result was reported by who observed that majority of species identified were from the Asteraceae family and Poaceae family.

Weed density (WDm2)

Xanthium strumarium weed species belongs to the family Asteraceae was recorded with a high weed density value (9.17plants/m2) among the identified weed species from surveyed areas, while Gynandropsis gynandra weed species belongs to the family capparidaceae was recorded with a low weed density value (0.73 plants/m2) (Table 4). Top five superior species under different weed families recorded with weed density were Xanthium strumarium (9.17plants/m2), Tussilago farfara (5.33plants/m2), Avena fatua (2.87plants/m2), Cyperus assimilis (2.83plants/m2) and Eriocloa fatmensis (2.73plants/m2). Mainly the weed species with the higher frequency percentage value was higher weed density value, however, in some cases, the higher frequency value showed lower density value when compared with one to the other weed species. If there is high weed density, there is low crop yield because crops might have grown in stress whereas the weed might have severely competed and use the environmental resources perfectly as compared to the crop.

Heavy infestations of Xanthium strumarium can kill or distroye mize plant. Xanthium strumarium is one of the invasive alien species those posing negative impacts on country's biodiversity. Xanthium strumarium has been listed as a noxious weed (prohibited plants that must be controlled) and it is a major weed of row crops such as maize, soybeans, cotton and groundnuts in many parts of the world. It was ranked as the fourth, fifth, sixth and seventh most troublesome weed in maize, soyabean, cotton and groundnut, respectively. These rankings were based on distribution, abundance and difficulty of control. It can also invade pastures and grazing lands causing reductions in forage production. It is toxic to most domestic animals and possesses characteristics that are harmful to humans, animals and the environment. Similar results were found from and reported that if the specific plant species had higher frequency and dominance value, it indicates the economic importance of it. Therefore, this study confirmed that these aggressive weed species are the major social, environmental and economic threats in the study area. Special attention and strategic plan required for the management of these aggressive weed species.

Frequency percentage (%)

Irrigated maize weed species were recorded with different frequency values from place to place. Averaged over locations, the frequency value of the weed species ranged from 100% and 20% (Table 4). The highest frequency value (100%) recorded by Xanthium strumarium followed by Tussilago farfara (83%) and Cyperus assimilis (80%). Whereas, the least frequency value recorded from Phyllanthus niruri (20%) followed by Polygonum nepalense(26%), Argemone mexicana and Medicago polymorpha that recorded (30%). The top-ranking weeds species Xanthium strumarium was the most aggressive and difficult weeds to control in different surveyed areas. High frequency of these weeds showed that they are a serious problem in all agricultural fields.

The five superior weed frequency across surveyed area an averagely were Xanthium strumarium (100%), Tussilago farfara (83%), Cyperus assimilis (80 Cyperus esculentus (73%) and Avena fatua (70%) (Table4). Among the top five weed species 10% and 90% were perennial and annuals, respectively, while 40% of them were broad leaves, 40% of them were sedage and the remaining 20% were grass weed species. Broad leaved weed are devastating effect on quality reduction through the mixing of weed seed. It also affect maize yield by competing with the maize crop plant for light, water and nutrient. Unless the weeds are controlled timely and adequately they can affect maize productivity and

Table 3. Number and proportion of weed species within fifteen diverse families of surveyed fields.

No	Family	Number of species	Percent Flora
1	Asteraceae	7	25.92
2	Chenopodiaceae	3	11.11
3	Gramineae	3	11.11
4	Cyperaceae	2	7.41
5	convolvulaceae	2	7.41
6	Leguminosae	1	3.7
7	Boraginaceae	1	3.7
8	Phyllanthaceae	1	3.7
9	Polygonaceae	1	3.7
10	Papaveraceae	1	3.7
11	solanaceae	1	3.7
12	caryophyllaceae	1	3.7
13	Cleomaceae	1	3.7
14	Anthericaceae	1	3.7
15	capparidaceae	1	3.7

production from year to year. This means finally it results in yield loss, poor quality and low price of maize crops. A similar finding reported by was revealed that different frequencies of different weed species including broad leaves, grasses, and sedges. Most of the common weeds in all surveyed areas were found in annual nature followed by perennials. (Singh et al, 2008) suggested that seeds of annual weeds survive in unfavorable conditions and they have able to complete their life cycle from seed to seed in a season.

Weed dominance and weed abundance

Across the surveyed areas the weed dominance ranged between 10.43% and 2.35% % which was recorded by Xanthium strumarium and Ipomoea eriocarpa, respectively. Following Xanthium strumarium, the dominance values and in descending order the top five weed species were Tussilago farfara (7.28), Avena fatua (4.65), Eriocloa fatmensis, Cyperus assimilis, Cyperus esculentus that recorded (4.55) (Table 4)

Relative abundance provides an indication of the overall weed problem posed by a species (Ramirez et al., 2015). The abundance value of the species varied from 9.17 to 2.07 plants m-2. The highest abundance value (9.17 plants m-2) was recorded by Xanthium strumarium followed by Tussilago farfara.(6.40 plantsm-2), Eriocloa fatmensis, Cyperus assimilis, Cyperus esculentus that recorded (4 plants m-2). Whereas, the least abundance value (2.07 plants m-2) was recorded for Ipomoea eriocarpa (Table 4). Among the five most abundant species, two of them are broad leave. In general, there were positive and significant correlations among frequency, abundance and dominance, that is the higher the frequency of the weed species, the higher will be its abundance and dominance and vice versa. Similar results were found from reported that if the specific plant species had higher frequency and dominance value, it indicate the economic importance of it. Therefore, this study confirmed that Xanthium strumarium is one of the major social, environmental and economic threats in the study area.

In all surveyed areas the most dominance and abundant weed species was Xanthium strumarium which is spiny broad leaved and annual. Xanthium strumarium has been identified as one of the top 20 invasive plant species which are distributed in a widespread range across Ethiopia (Rezene and Taye, 2010). In Ethiopia, it has showed that a high distribution status, but little is known about its impact

Table 4. Description of frequency percentage, field uniformity, weed abundance, weed dominance and weed density in irrigated maize fields in shebele zone, somale regione, Ethiopia.

Family	Weed species	FP (%)	FU (%)	WA	WD (%)	WDm²
Anthericaceae	Chlorophytum comosun	60	40	3.61	4.11	2.17
Boraginaceae	Heliotropium cinerascens	36	24	2.64	3	0.97
Capparidaceae	Gynandropsis gynandra	33	22	2.20	2.5	0.73
Caryophyllaceae	Stellaria media	60	40	2.72	3.09	1.63
Chenopodiaceae	Atriplex patula	56	37	2.65	3.01	1.5
	Chenopodium album	46	31	2.21	2.51	1.03
	Chenopodium opulifolium	50	33	2.6	2.96	1.3
Cleomaceae	Cleome rutidosperma	36	24	2.45	2.79	0.9
Asteraceae	Tussilago farfara	83	55	6.40	7.28	5.33
	Chrysanthemum segetum	43	29	2.08	2.36	0.9
	Circium vulgare	46	31	2.78	3.16	1.3
	Lactuca virosa	43	29	2.38	2.7	1.03
	Guizotia scabra	53	35	2.25	2.56	1.2
	Spilanthes mauritiana	36	24	2.81	3.2	1.03
	Xanthium strumarium	100	66	9.17	10.43	9.17
Convolvulaceae	convolvulus arvensis	60	40	2.44	2.77	1.47
	Ipomoea eriocarpa	50	33	2.07	2.35	1.03
Cyperaceae	Cyperus assimilis	80	53	4	4.55	2.83
	Cyperus esculentus	73	49	4	4.55	2.67
Gramineae	Avena fatua	70	46	4.09	4.65	2.87
	Digitaria abyssinica	66	44	3.9	4.43	2.6
	Eriocloa fatmensis	66	44	4	4.55	2.73
Leguminosae	Medicago polymorpha	30	20	3	3.41	0.9
Papaveraceae	**Argemone Mexicana**	30	20	2.78	3.16	0.83
Phyllanthaceae	Phyllanthus niruri	20	13	3	3.41	0.93
Polygonaceae	Polygonum nepalense	26	17	3.54	4.03	1.4
Solanaceae	Datura stramonium	56	37	3.18	3.62	1.8

FP = Frequency percentage; FU = Field uniformity; WA = Weed abundance; WD = Weed dominance; WDm2 = Weed density.

on species richness, evenness diversity and composition of native plant species on invaded community. Xanthium strumarium also has an economic impact in pastures, where cattle, sheep and pigs may be poisoned by eating young plants. The cotyledons contain a toxic compound, carboxyatractyloside, which is absent in older plants. Symptoms include vomiting, muscular spasms, liver degeneration and occasionally death. Xanthium strumarium produces large amounts of highly antigenic pollen and the glandular hairs on the leaves and stem secrete a substance which causes contact dermititis in allergic individuals.

Field uniformity

Among 27 identified weed species high value of field uniformity was observed with Xanthium strumarium (66%), while the lowest was recorded with Phyllanthus niruri (13%). The top five weed species with decreasing order field uniformity were Xanthium strumarium (66%), Tussilago farfara(55), Cyperus assimilis (53%), Cyperus esculentus (49%), Avena fatua (46%) (Table 4). Whereas, the remaining 22 weed species were recorded with field uniformity value ranging between 44% and 17%. This dissimilar may occur due to edaphic (including soil pH, soil moisture, etc) and biological (dominated by another weed species, seed dormancy, eaten by insects and micro-organisms and etc) factors. A similar result was reported by in a rice field.

Species richness

A total of 27 weed species belonging to 15 families were recorded. Asteraceae was recorded as dominant family and contained a total of 7 weed species (Table 3). From those 7 weed Species in the surveyed fields the recorded individual weed count per quadrant was 599 plants/m2. From Asteraceae family 7 weed species with decreasing order Species richness or individual weed count per quadrant were Xanthium strumarium (275 plants/m2), (Tussilago farfara (160 plants/m2), Circium vulgare (39 plants/m2), Guizotia scabra (36 plants/m2), Lactuca virosa and Spilanthes mauritiana recorded data was (31 plants/m2), Chrysanthemum segetum (27 plants/m2,) (Table 4). The surveyed fields heaveiy invaded by Xanthium strumarium. Xanthium strumarium invasion heavily distresses the composition and structure of plant species in the invaded study areas. Species richness and diversity were generally higher during the cropping season. Among families, the highest Percent Flora 25.92% was recorded from Asteraceae and Species richness or individual weed count per quadrant was 599 plants/m2. While the least Percent Flora 3.7%, one species was recorded from individual family of ten different families (Table 2). The surveyed fields were highly species rich by Xanthium strumarium which is s is one of the most invasive weeds. Xanthium strumarium were producing allelo-chemicals that retarded the crop growth and further reduced yields. The allelochemicals released from Xanthium strumarium inhibit the growth of pasture grasses, legumes, cereals, vegetables, other weeds, and even trees.

The survey result showed that the most important families in gode and kelafo districts, shebele zone,Ethiopia based on the number of weeds was Asteraceae families. These surveyed results are supported by and who reported Asteraceae, Poaceae and Fabaceae family's families were also the most important in small-scale farming in Highland Peru, Central Mexico, Northern Zambia, Eastern and Southwestern Ethiopia. These families are very species rich, so it is not surprising that they contain many weeds. The weed flora in crop fields of eastern gode and kelafo districts, shebele zone,Ethiopia was dominated by few common species. Xanthium strumarium as a noxious weed species in Asteraceae get top family in ranking than other families. So that these families were the most diverse family compared to other families. In other words the surveyed fields were species rich in annual broad leaved and followed by grass and sedge. Annual Broad leaved weeds might have severely strived and utilizes the environmental resources perfectly for longer period of time and accumulated higher dry matter. The results are in accordance with those of who reported that an increase in weed dry weight with increased competition periods in black seed and fennel crops respectively. It seems that in arable lands due to continuous tillage, growth conditions are more favorable for annual weeds in comparison with perennial weeds.

Weed cover and Level of weed infestation

This study recorded that 27 weed species belonging to 15 families. The weeds were predominantly broadleaf and the order of abundance in their occurrence were Asteraceae > Chenopodiaceae = Gramineae > Cyperaceae = Convolvulaceae and all the other familes were equal (Table 3). The broadleaved weeds were more in abundance followed by grasses and sedges (Table 2). The top ranking level of weed infestasion in the surveyed fildes were Xanthium strumarium and Tussilago farfara (+++) followed by Cyperus esculentus, Chenopodium album, Chenopodium opulifolium, Argemone Mexicana (++) (Table 5).

In the survey fields, Xanthium strumarium and Tussilago farfara weed coverage was higher (5), followed by Cyperus esculentus, Cyperus assimilis, Chenopodium album, Chenopodium opulifolium, Eriocloa fatmensis, Argemone Mexicana and Chlorophytum comosun (3) (Table 5). In general the surveyed fields were high level of weed infestation and weed cover by broad leaved followed by grass and sedage. The high level of weed infestation and weed cover were by the family of Asteraceae from these family weed species Xanthium strumarium and Tussilago farfara were highly infest and cover the surveyed felids. Especially Xanthium strumarium weed species had the highest level of weed infestation and weed cover in all surveyed fields. Xanthium strumarium which is annual broad leaved weed species was found the most dominant plant species in surveyed sites. Xanthium strumarium was the second most problematic weed and highly problematic in the Lower Middleveld and Lowveld.

Table 5. Family, weed species, species richness, weed cover and their level of weed infestation in surveyed fields.

Family	Weed species	SR(individual weed count per quadrant)	WI	WC
Anthericaceae	Chlorophytum comosun	65	+	3
Boraginaceae	Heliotropium cinerascens	29	+	0
capparidaceae	Gynandropsis gynandra	22	+	0
Caryophyllaceae	Stellaria media	49	+	0
Chenopodiaceae	Atriplex patula	45	+	0
	Chenopodium album	31	++	3
	Chenopodium opulifolium	39	++	3
Cleomaceae	Cleome rutidosperma	27	+	0
Asteraceae	Tussilago farfara	160	+++	5
	Chrysanthemum segetum	27	+	0
	Circium vulgare	39	+	0
	Lactuca virosa	31	+	0
	Guizotia scabra	36	+	1
	Spilanthes mauritiana	31	+	0
	Xanthium strumarium	275	+++	5
Convolvulaceae	convolvulus arvensis	44	+	0
	Ipomoea eriocarpa	31	+	1
Cyperaceae	Cyperus assimilis	85	+	3
	Cyperus esculentus	80	++	3
Gramineae	Avena fatua	86	+	0
	Digitaria abyssinica	78	+	0
	Eriocloa fatmensis	80	+	3
Leguminosae	Medicago polymorpha	27	+	0
Papaveraceae	**Argemone mexicana**	25	++	3
Phyllanthaceae	Phyllanthus niruri	18	+	0
Polygonaceae	Polygonum nepalense	32	+	0
Solanaceae	Datura stramonium	54	+	2

SR= Species richness ,WI = level of weed infestation, WC = weed cover; +++ - High infestation (60 – 90% occurrence), ++ - moderate infestation (30 – 59% occurrence) and + -low infestation (1- 29% occurrence); 0-Sparsely present, 1- Plentiful but with small coverage, 2- Numerous or covering 1/2 of the area, 3- Number of weed species covering ¼ to ½ of the area, 4- Number of weed species covering ½ to ¾ of the area and 5- Weed species covering more than ¾ of the area.

The negative relationship between coverage of Xanthium strumarium and Species diversity, evenness and richness in the study areas might be due to Xanthium strumarium has allopathic property. In other words it might be due to the environmental conditions (soil, temperature, rainfall, altitude etc.) were favorable to Xanthium strumarium than the other plants in the study areas. Moreover, other similar study by confirmed that Xanthium strumarium can tolerate a variety of soil conditions ranging from moist clay to dry sand. It also tolerates flooding at all growth stages. Their study also indicated, Xanthium strumarium is able to grow in different types of habitat. Therefore, such ecologically diversified adaptability of Xanthium strumarium allows its rapid expansion and speedup the damaging impacts on animals and plants as well as their products, resulting in monoculture formation and native biodiversity reduction . Other similar study by Grice, (2006) on the impacts of invasive plant species on the biodiversity indicated that Xanthium strumarium grows faster having short life cycle, greater reproductive potential, competitive ability and allelopathy that make it successful invader.

Similarity indices

Similarity index is the similarity of plant species composition among different kebeles in two districts from one zone. The result showed a similarity index value of 76-79%, 76 - 83% and 82% among the kebebes of gode and kelafo districts and shebele Zone respectively (Tables 6- 8). This suggests

Table 6. Similarity index of weed species in the 3 kebeles of Gode district.

Location	Bedelat	Goderhey	Barsan
Bedelat	100	79	63
Goderhey		100	76
Barsan			100

Table 7. Similarity index of weed species in the 3 kebeles of Kelafo district.

Location	Dariqo	Musadon	Allawiqatsi
Dariqo	100	76	78
Musadon		100	83
Allawiqatsi			100

Table 8: Similarity index of weed species in the two district of Shebelle zone.

Location	Gode	Kelafo
Gode	100	82
Kelafo		100

that the weed species composition among the different the kebeles were similar by 76-79%, 76 - 83% and 82%. According to these indices are considered elevated when they are above 0.5 (50%), at which a high similarity can be interpreted between areas. The high values indicate less environmental heterogeneity and low values imply high environmental heterogeneity. As described by if the index of similarity is below 60%, it is said that the two locations have different weed communities. Since similarity indices for the different location were greater than 60% it can be concluded that the locations exhibited similar weed community and thus, require similar management options. The difference in altitude, climate, soil types and field management practices applied to the different district could be the cause that affected the distribution, abundance and dominance of the weed species Noted that weed growth, population density and distribution vary from place to place depending upon soil and climatic factors that affect the weed flora, and farmers' management practices (Table 6, 7)

CONCLUSIONS AND RECOMENDATION

Based on the present weed survey study, the total of twenty seven different maize weed species that belongs to 15 families were assessed and identified. In the survey fields, relatively the most abundant and dominated top six weed species (Xanthium strumariu, Tussilago farfara, Avena fatua, Eriocloa fatmensis, Cyperus assimilis, Cyperus esculentus) were identified. The importance of each species was determined by calculating the weed density, field uniformity, frequency, abundance and dominance values. The most dominant family according to the frequency and number of weed species was Asteraceae. The most aggressive and difficult-to-control weeds in the fields was identified which is Xanthium strumarium. Xanthium strumarium grows faster having short life cycle, greater reproductive potential, competitive ability and allelopathy that make it successful invader and able to grow in different types of habitat. It allows its rapid expansion and speedup the damaging impacts on animals and plants as well as their products. Therefore, there is a need of better planning to control, manage and eradicate the spread of Xanthium strumarium by establishing communication links between Regional, Zonal, district and Kebele Agricultural Office and other concerned bodies. In addition to this, strong local support and commitment from the government and individuals will more likely facilitate in the control, management and/or eradication of Xanthium strumarium on private land before it spreads to other districts, zones and regions. Timely control of the weed by adopting appropriate methods especially with an integrated weed management approach is essential. Therefore, maize growers should be used sound and sustainable weed management practices including cultural, chemical, and integrated weed management approaches, and further weed management studies should be conducted. Similarity indices of weed communities in different locations were also determined to be >60% across all locations sampled.

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