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Assessments and Identification of Major Weed of Hot Pepper (*Capsicum annuum* L.) in West Shoa and East Wollega Zones, Ethiopia

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Abstract: Hot pepper is the most important vegetable crop belonging to the family Solanaceae and grown as a spice crop in different parts of the world. Hot pepper is one of the important cash crops to Ethiopian smallholder farmers and an important agricultural commodity which contributes to export earnings. Peppers cultivation in the field are subject to biotic and abiotic factors effects that influence the yield. Weeds emerge fast and grow rapidly competing with the crop for growth resources viz., nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages of hot pepper. there is a dire need of identification major hot pepper weed in the study area for develop management option and this activity was initiated to assess and identify distribution and status of major hot pepper weeds in the study area. The weed survey was conducted in West Shoa and East Wollega Zones of Oromia Reginal state during 2020 main cropping season. The weed Survey was conducted to assess Abundance, Dominance and Frequency of major Hot pepper weeds. Kebeles were randomly selected from each District and based on the representativeness of hot pepper production of the area. Weed survey was performed along two diagonals ("X" pattern) of a five points field of 1m x 1m (1 m^2) quadrates. A total of 46 weed fields were surveyed from Hot Pepper farms of Ilu Galan, Bako Tibe, Sibu Sire and Boneya Boshe Districts. From study fields 15 weed family and 39 weed species were recorded and identified. The assessments result also showed that, Broad leaf weeds dominate over grass and sedge weed species. 76.92% broad leaf, 17.95% grass types, and 5.13% sedge types from a total of 39 weed species of hot pepper farm fields. The occurrence of each weed species ranged from 2.78 up to 97.22% while the dominance value ranged from 0.3% up to 28%. The most common and prevailing weed was Ageratum conyzoides L. and Guizotia scarab in hot pepper field. Hence when developing a weed management approach in the future, different weed controlling options must be planed next coming years, toward those major Weed families and species; especially broad leaf weed.

Keywords: Assessments, Distribution, Major Weed, Hot Pepper

1. Introduction

Hot pepper (*Capsicum annuum* L.) is the most important vegetable crop belonging to the family Solanaceae and grown as a spice crop in different parts of the world [1]. Pepper is an agriculturally significant crop in most developing countries providing an important nutrient source and addresses food needs and job creation throughout the crop value chain [2, 3]. The total area devoted to hot pepper is estimated 29% [4]. Hot pepper is the leading vegetable crop produced in the Ethiopia. The national production of green and dry hot pepper was 632,404.53 and 2,647,225.30 tones with average productivity of 61.96 and 17.33 tones ha respectively [5]. Thus, Capsicum productivity in Ethiopia is far below the world average that strongly demands immediate productivity improvement. People consume pepper for intake enhancement as well as to supplement the dietary needs. It is also one of the major income generating crops for most households of the pepper producing areas and plays a vital role in food security in Ethiopia [6].

Hot pepper is one of the important cash crops to Ethiopian smallholder farmers and an important agricultural commodity

which contributes to export earnings [7]. The nutritional value of hot pepper merits special attention. It is rich source of vitamin A, E and contains five to six times as much vitamin C as an orange or a lemon, making it an ideal vegetable to prevent flu colds more than any other vegetable crop [8]. The color (Oleoresin) and flavor extracts from hot pepper are used in both food and feed industries. The average daily consumption of hot pepper by an Ethiopian adult is estimated to be 15 g which is higher than tomatoes and most other vegetables [9], indicating the significance of the crop in the country.

Peppers cultivation in the field are subject to biotic and abiotic factors effects that influence the yield. Some of the factors that negatively affect crop growth, development and yield is the plant density, presence of weeds and low soil fertility [10]. Chilli pepper culture is extremely susceptible to the interference of these plants because it presents slow initial growth and low index of leaf area in relation to it [11].

Weeds emerge fast and grow rapidly competing with the crop for growth resources viz., nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages of chilli. The wide space provided in between chilli plants allows fast growth of different weed species, causing considerable reduction in yield.

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Weeds emerge fast and grow rapidly competing with the crop for growth resources viz., nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages of hot pepper. The wide space provided in between hot pepper plants allows fast growth of different weed species, causing considerable reduction in yield. Optimum plant spacing ensures proper growth and development of plant resulting in maximum yield of crop and economic use of land. Yield of hot pepper has been reported to be dependent on the number of plants accommodated per unit area of land [12].

Thus it could be crucial to look for assessments major weed of hot pepper. Therefore, there is a dire need of identification major hot pepper weed in the study area for develop management option and this project was initiated with the objective of to assess and identify distribution and status of major hot pepper weeds in the study area.

2. Materials and Methods

2.1. Description of Study Area

The weed survey was conducted in West Shoa and East Wollega Zones of Oromia Regional state during 2020 main cropping season during at early vegetative and pod setting of hot pepper. The weed assessment survey was conducted in the two Districts of West Shoa Zone Ilu Galan and Bako Tibe and in Two District of East Wollega Zone Sibu Sire and Boneya Boshe. The weed Survey was conducted to assess Abundance, Dominance and Frequency of major Hot pepper weeds. The annual and mean minimum and maximum temperature of the area 14.5°C and 19.3°C, respectively while the annual rainfall is 1605.7 mm (Table 1). The geographical locations of the surveyed areas were located in the rage of latitude and longitude of 08°55'10.89"-09°05'04.87"N and 036°44'35.44"- 037°60'22.73"E, respectively (Figure 1).

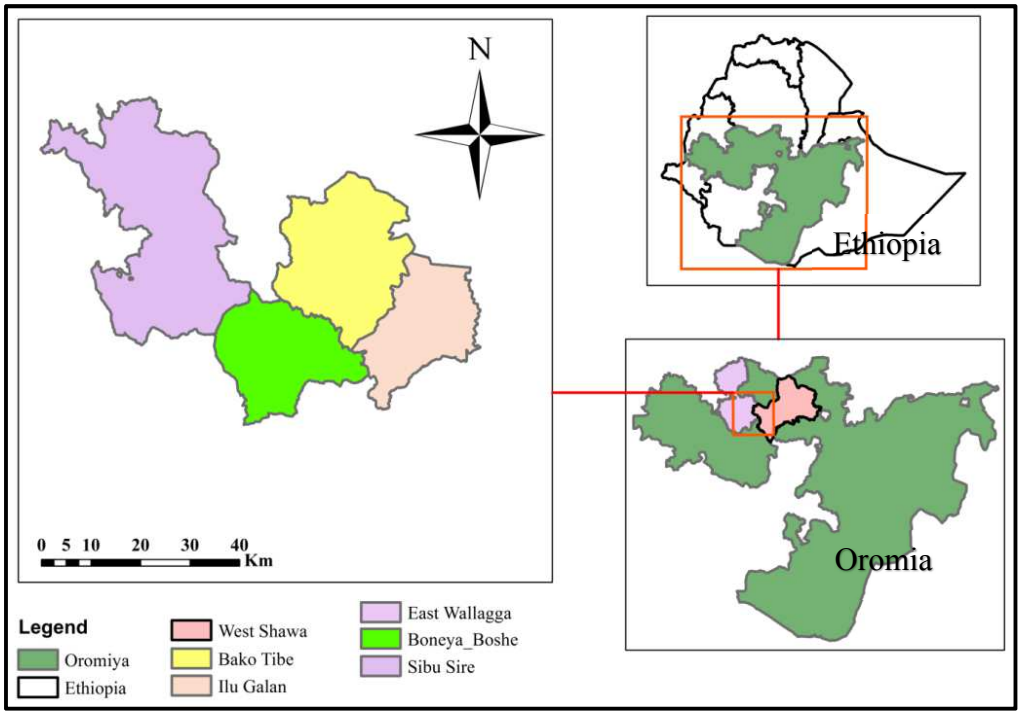

Figure 1. *Map of survey site.*

Table 1. *Meteorology data last ten years (annual temperature and annual rain fall).*

year	annual mean minmum temprature	annual mean muximum temprature	annual mean rain fall
2011	13.5	27.3	1425.5
2012	13.7	28.7	889.8
2013	12.9	29	1432.6
2014	13.4	28.4	1066.4
2015	12.4	29.9	931.4
2016	14.1	29.7	1330.7
2017	12.7	29.1	1599.5
2018	14	30	1267.1
2019	14.2	29	1342.3
2020	14.5	29.3	1605.7

Source: Bako Agriculture Research Center Meteorology station.

2.2. Hot Pepper Field Survey

The hot pepper weed assessment was conducted in four Districts of two Zones during main seasons of in all surveyed Districts of two zones. The four districts had almost near to midland and highland agro-ecologies. It lies at an altitude 1610-2083m.a.s.l. elevation (Table 2). In this area most farms fields covered by hot pepper from vegetables next to cereal crops. The survey was conducted in 32 Kebeles and 46 Fields in the four Districts of the two Zones. The sample was done using random sampling technique assessment. Kebeles were randomly selected from each District and based on the representativeness of hot pepper production of the area (Table 2). The locations were at least 4-7 km apart and the distance locations depended on the topography and the relative importance of crop production within each location. Weed survey was performed along two diagonals ("X" pattern) of a five points field of 1m x 1m (1 m^2) quadrates and some questioner rise to farmers.

Table 2. *Characteristic features of surveyed hot pepper fields in two Zones of study area.*

Zones	Districts	Altitude (m.a.s.l)	No. field assessed
East Shoa	Ilu Galan	1705-1793	5
	Bako Tibe	1610-1768	14
	Mean	1610-1793	19
East Wollega	Sibu Sire	1711-2083	18
	Bilo Boshe	1655-1778	8
	Mean	1655-2083	26
	Over all mean	1610-2083	45

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

The status the crop, the weed available, the types of infestation, the infestation level, the level of farmers'/workers knowledge about the problem of weeds and the control options used were collected. Data for the two times survey of weeds were combined and summarized. Frequency (F), Abundance (A), Dominancy (D) and Similarity Index (SI), which were computed for each species using the method of [13]. The hot pepper weed management practices; like source variety sown whether, previous crop (cereals, pulses or vegetables), planting date (sowing) crop density, altitude, weed density per meter square, fertilizer type and rate, soil type, growth stage, weeds type observed and herbicides used were collected as to the survey format. Most of hot pepper local cultivars assessed during the survey time and recorded. In each field, weeds species and their numbers within the quadrates were counted and recorded.

2.3. Data Tobe Analyses

After the qualitative weed measurements these parameters, Density, Relative Density, Frequency, Relative Frequency and Similarity index were calculated by using SPSS Software.

$$\text{Density (D)} = \frac{Total\ number\ of\ individuals\ of\ a\ species\ in\ all\ quadrate}{\text{Total number of quadrates used}}$$

$$\text{Frequency (F)} = \frac{Number\ of\ quadrates\ in\ which\ a\ given\ species\ occurs}{\text{Total number of quadrates used}}$$

$$\text{Relative Density (RD)} = \frac{\text{Density of a given species}}{\text{Total density for all species}} \text{ X } 100\%$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of a given species}}{\text{Total frequency for all specie}} \text{ X } 100\%$$

$$\text{Summed Dominant Ratio (SDR)} = \frac{\text{Relative density}}{\text{Relative frequency}} \text{ X } 100\%$$

$$\text{Similarity Index (SI)} = 100 \text{ x Epg/(Epg + Epa + Epb)}$$

Where; SI = Similarity index, Epg = number of species found in both locations, Epa = number of species found only in location I. Epb = number of species found only in locations II.

3. Result and Discussion

3.1. Diversity of Weeds

A total of 46 weed field were surveyed from Hot Pepper farmers of Ilu Galan, Bako Tibe, Sibu Sire and Boneya Boshe Districts. Ilu Galan and Bako Tibe Districts from West shoa and Sibu Sire and Boneya Boshe Districts from East Wollega Zone during 2020 cropping season. From study fields 15 weed family and 39 weed species were recorded and identified. Asteraceae (8spp.), Poaceace (7spp.), Commelinaceae (5spp.) and Amaranthaceae (4spp.) found to be 1st, 2nd, 3rd and 4th abundant weeds families respectively (Table 3) and thes families were share 61.5% of the total

species of the studies area in number. Asteraceae, Poaceace and Fabaceae were also found to be most important in the other studies of tropics [14]. These weed species might be due to their adaptability under a wide range of environmental conditions and soil types, growth behavior, prolific seed production, long lasting production, long lasting dormancy and highly competitive ability of weed species present in the families. However, the number and the identity of the weeds varied in different hot pepper fields.

3.2. Weed Flora of Hot Pepper Fields

In hot pepper fields about 39 weed species were identified and Among these, 35 species were annuals and 4 perennials. the assessments result also showed that, Broad leaf weeds dominate over grass and sedge weed species. 76.92% broad leaf, 17.95% grass types, and 5.13% sedge types from a total of 39 weed species of hot pepper farm fields (Table 3). From a total 39 weed species *Agratum conyzoides*, *Guizotia scarba (Vis) Chiov, Eleusina indica, Galinsoga parviflora*, *Oplismenus compositus (L.) P. Beauv., Commonina Bangilansis*, *Cynodon dactylon (L.) Pers., Setaria pumila* and *Anagallis arvensis* were recorded and widely distributed with higher than 30% frequency while the lower than 10% frequency value was recorded from 9 weed species on surveyed crop fields. The species that had the highest frequency 97.22% was *Agratum conyzoides* and followed by 88.89% and 63.89% *Guizotia scarba (Vis) Chiov* and *Eleusina indica* respectively among the survey weed flora. The occurrence of each weed species ranged from 2.78 up to 97.22% (Table 4).

Table 3. *Number of weed families and number of species they comprise in the hot pepper fields.*

No.	Family	No. of species	No.	Family	No. of species
1	Asteraceae	8	9	Brassicaceae	1
2	Poaceace	7	10	Capparaceae	1
3	Commelinaceae	5	11	Lamiaceae	1
4	Amaranthaceae	4	12	Nyctaginaceae	1
5	Caryophyllaceae	2	13	Papavaraceae	1
6	Cyperaceae	2	14	plantaginaceae	1
7	Polygonaceae	2	15	Portulacaceae	1
8	Solanaceae	2	-	-	
	Total			-	39

Table 4. *Description of Weed Density, Frequency, Relative Density and Relative Frequency in hot pepper fields.*

Botanical name	Family	Category	Life cycle	Density	Freq.	Relative Density	Relative Freq.
Achyranthes aspera	Amaranthaceae	Broad leaf	Annual	0.19	13.89	0.34	1.57
Agratum conyzoides	Asteraceae	Broad leaf	Annual	28	97.22	49.53	11.01
Amaranthus spinosus L.	Amaranthaceae	Broad leaf	Annual	0.39	5.56	0.69	0.63
Anagallis arvensis	Commelinaceae	Broad leaf	Annual	1.69	30.56	2.99	3.46
Argemone mexicana L	Papavaraceae	Broad leaf	Annual	0.08	2.78	0.14	0.31
Bidens plosa	Asteraceae	broad leaf	Annual	0.05	2.78	0.09	0.31
Boerhavia erecta L.	Nyctaginaceae	broad leaf	Annual	0.11	5.56	0.19	0.63
Celocia trigyna	Amaranthaceae	Broad leaf	Annual	0.42	16.67	0.74	1.89
Chenopodium procerum (Hochst ex.)	Amaranthaceae	broad leaf	Annual	0.22	11.11	0.39	1.26
Cleome monophylla L.	Capparaceae	Broad leaf	Annual	0.11	5.56	0.19	0.63
Commonina Bangilansis	Commelinaceae	Broad leaf	Annual	1.47	52.78	2.6	5.98
Commonina sublulata	Commelinaceae	Broad leaf	Annual	0.39	11.11	0.69	1.26
Conyza Canadensis (L.)	Asteraceae	broad leaf	Annual	0.03	2.78	0.05	0.31
Cynodon dactylon (L.) Pers.	Poaceace	Grass	Perennial	1.97	41.67	3.48	4.72
Cyanotis cristata (L.) D. Don.	Commelinaceae	Broad leaf	Annual	0.97	27.78	1.72	3.15
Commelina subulata Rott.	Commelinaceae	Broad leaf	Annual	0.28	8.33	0.5	0.94
Cyperus rotudus L.	Cyperaceae	Sedge	Perennial	0.53	22.22	0.94	2.52
Datura stramnninm L.	Solanaceae	broad leaf	Annual	0.28	2.78	0.5	0.31
Digitaria abvssinica (A. Rich.)	Poaceace	Grass	Annual	0.42	16.67	0.74	1.89
Digitaria ternata (A. Rich.) Stapf	Poaceace	Grass	Annual	0.78	27.78	1.38	3.15
Eleusina indica	Poaceace	Grass	Annual	2.08	63.89	3.68	7.24
Erucastrium arabicum (Fisch. & May)	Brassicaceae	Broad leaf	Annual	0.69	16.67	1.22	1.89
Galinsoga parviflora	Asteraceae	broad leaf	Annual	2.53	61.11	4.48	6.92
Guizotia scarba (Vis) Chiov	Asteraceae	Broad leaf	Annual	5.83	88.89	10.31	10.07
Kyllinga nemoralis L.	Cyperaceae	sedge	Perennial	1.05	13.89	1.86	1.57
Leucas cephalotes (Roth) Spreng	Lamiaceae	broad leaf	Annual	0.19	11.11	0.34	1.26
Nicandra physalodes (L.) Gaertn.	Solanaceae	Broad leaf	Annual	0.72	25	1.27	2.83
Oplismenus compositus (L.) P. Beauv.	Poaceace	Grass	Annual	2.08	47.22	3.68	5.35
Oxygonmn sinuatum (Meisn.) Dammer	Polygonaceae	Broad leaf	Annual	0.06	2.78	0.11	0.31
Plantago lanceolata L.	plantaginaceae	Broad leaf	Perennial	0.36	8.33	0.64	0.94
Polygnom nepalensi Meisn.	Polygonaceae	Broad leaf	Annual	2.36	47.22	4.17	5.35
Portulaca oleracea L.	Portulacaceae	Broad leaf	Annual	0.03	2.78	0.05	0.31
Setaria pumila	Poaceace	Grass	Annual	1.81	38.89	3.2	4.4
Snowdenia polystachya	Poaceace	Grass	Annual	0.03	2.78	0.05	0.31
Spergula avensis L.	Caryophyllaceae	Broad leaf	Annual	0.33	11.11	0.58	1.26
Spilanthes mauritiana (Rich.ex Pers)	Asteraceae	Broad leaf	Annual	0.03	2.78	0.05	0.31
Stellaria media (L.) Vill.	Caryophyllaceae	Broad leaf	Annual	0.33	8.33	0.58	0.94
Tagetes minatu L.	Asteraceae	Broad leaf	Annual	0.03	2.78	0.05	0.31
Xanxhium strumarium L.	Asteraceae	Broad leaf	Annual	0.61	22.22	1.08	2.52

The predominant weed was a species found relatively more than any other species. The highest degree of invasion (predominance) ranges from 0.03% to 28%, and most of the weed found associated with the hot Pepper production areas were weeds that emerge with or before the crop. Weeds that emerge later than the crop are much less competitive in terms of crop yield loss but still may be consider problematic if they influence crop harvest ability or reduce crop quality. Weed density is an important factor in the control of weed species as explained by [15]. He elaborated his claim by disclosing that where the average density of the species was less than 9 weeds/m^2 but, some species were found greater density within the specific field.

3.3. Weed Similarity Index

Similarity index (community index) is the similarity of plant species composition among different Districts. The weed flora similarity index of Ilu Galan, Bako Tibe, Sibu Sire and Boneya Boshe Districts were above 60% which means 63% to 91% that similar weed management method can be used to control weed species composition (Table 5). This suggests that the weed species composition among different Districts were similar. 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 [16-18].

Table 5. *Characteristic feature similarity index of weed species composition in hot pepper fields.*

Districts	Ilu Galan	Bako Tibe	Sibu Sire	Bilo Boshe
Ilu Galan	100	79	66	63
Bako Tibe		100	87	77
Sibu Sire			100	91
Bilo Boshe				100

4. Conclusion

A total of 46 weed fields were surveyed from Hot Pepper farms, from study fields 15 weed family and 39 weed species were recorded and identified. The importance of each species was determined by calculating the frequency, Abundance and dominance values. The most dominant families according to frequency and number of weed species were Poaceace, Asteraceae, Commelinaceae and Amaranthaceae. The occurrence of each weed species ranged from 2.78 up to 97.22% while the dominance value ranged from 0.3% up to 28%. The most common and prevailing weed was *Ageratum conyzoides* L and *Guizotia scarab* in hot pepper field. Between studies Districts similarity index were 63%-91% which means, similar weed management mothed can be used to control weed species in all Districts. Hence when developing a weed management approach in the future, different weed controlling options must be planed next coming years, toward those major Weed families and species; especially broad leaf weed.

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