American Journal of Plant Biology
2021; 6(4): 89-94
http://www.sciencepublishinggroup.com/j/ajpb
doi: 10.11648/j.ajpb.20210604.13
ISSN: 2578-8329 (Print); ISSN: 2578-8337 (Online)

Weed Species Dominance and Abundance in Tea (*Camellia sinensis* L.) Plantation of Southwest Ethiopia

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To cite this article:

Tigist Bidira, Tamiru Shimales, Melaku Adissu, Tadesse Eshetu. Weed Species Dominance and Abundance in Tea (*Camellia sinensis* L.) Plantation of Southwest Ethiopia. *American Journal of Plant Biology.* Vol. 6, No. 4, 2021, pp. 89-94. doi: 10.11648/j.ajpb.20210604.13

Received: August 19, 2021; **Accepted**: November 25, 2021; **Published**: December 24, 2021

Abstract: Tea (*Camellia sinensis* L.) is one of the most popular beverage crops. Among tea production constraints, weed is one of the detrimental factors in tea productions in Ethiopia. For the possibility of developing weed management method determining the dominant and abundant weed species is highly important to identify and prioritize the most noxious and prevalent weed that associated with tea production in the country. Weed flora survey was conducted in two different tea estate farms Wushwush and Gumero tea plantations in 2019/20 cropping seasons. The field survey was done according to the quantitative survey method by using $1m^2$ quadrate size. Weeds present in each quadrate were counted and identified to species level. Weed abundance, dominance, frequency and similarity index was determined at two tea producing locations. A total of 63 weed species were identified from assessed tea plantation farms. The result revealed that 61.3% and 71.9% of broad leaf weed was recorded at Wushwush and Gumaro tea plantation, respectively. Only, two (6.5%) parasitic weed species were recorded at Wushwush. The most prevalent and abundant weed species at Wushwush was *Ageratum conyzoides* followed by *Hydrocotyle americana*, whereas, *H. americana* was the most dominant species at Gumero tea plantation. Generally, from survey results, the weed flora composition was similar in both assessed areas, as its similarity index resulted above 70%. Hence, similar weed management methods should be recommended for both locations.

Keywords: Diversity, Frequency, Similarity Index, Species Composition

1. Introduction

Weeds are the major problem of concern for the low productivity and economic losses to the producers. They are unwanted plants that compete with the crop plants for nutrients, water, space and light [1], and this competitive ability of weeds depends on various unrelated factors such as growth form of weeds, their density and time of weed emergence in relation to crop [2].

Weeds are among the critical factors limiting productivity of tea plantation. Severity of weed infestation is primarily influenced by agro climatic conditions, types of tea culture and specific weed management schedule [3]. Weeds are constant component of agro-ecosystem [4]. Unlike occurrence of other pests, which may be random and irregular, weeds can considerably decline yields without understandable signs of damage in crop production [5]. They harmfully affect crop growth and yield by competing with crops for nutrients, sunlight, space, and water; producing allelopathic interaction with crops, being parasitic on to crop plants and sheltering detrimental insect pests and plant pathogens [6, 1, 7]. Weed can cause 50-70% loss of tea productivity if its growth not limited [3]. Accordingly, weeding is a key and inescapable operation in tea plantation. Weed growth, population density, and distribution vary from place to place depending upon soil, climatic factors, and farmers` management practices [4]. Information on weed density, distribution, and species composition may help to predict yield losses and such information helps in deciding whether it is economical to control a specific weed problem [8]. The floristic diversity and distribution of weeds within

the crop fields depends on the different factors [9].

Weed survey determines distribution, abundance, and diversity of the weed species in a given cropland or locality. For example, in Turkish tea plantations, 114 native and naturalized/cultivated vascular plant taxa were found out as weeds in tea plantations [10], which is something we lack insight into. Such information provides substantial criteria of an exact assay of weed infestation on crop land and serves as basis for planning and decision making for successful weed management. Options for weed management should consider such information and targeting the management of the most frequent, abundant and dominant species in a given area [11]. Hence, the study was conducted to identify, quantify and prioritize the most dominant and abundant weed species at Wushwush and Gumero tea plantation. However, there is no updated information on weed flora compositions, abundance, relative importance and ranking of weed species in the main tea growing areas of Southwestern part of Ethiopia. Therefore, this study was conducted to identify, document and prioritize diversity, abundance and species composition of weed in tea commercial farms i.e., Wushwush and Gumero tea plantation.

2. Materials and Methods

2.1. Description of the Study Areas

The study was conducted at Wushwush and Gumaro tea plantations. Wushwush tea farm located in Kaffa zone of Southern Nations Nationalities and Peoples Region (SNNPRs), is a mid to highland area with elevation of 1800masl. Gumero is suited in Iluababora zone of Oromia regional state of southwestern Ethiopia, with altitude of 1600masl [12]. Monthly average minimum and maximum temperatures were 13°C and 24°C at Wushwush and 12°C and 24°C at Gumaro [12].

2.2. Sampling Procedure and Identification of Weed Flora

The field survey was conducted in 2019/20 at Wushwush and Gumero tea plantation. A total of 35 quadrates for Wushwush and 20 quadrates for Gumero were considered. In each field, a pattern of an inverted W- pattern [13] was followed and two W patterns were used in each farm. The number of weeds was recorded by species in 1m x 1m ($1m^2$) quadrant. Unidentified weed species at field condition were identified using identification guide [14]. Based on the guides recorded, weed species were classified based on their morphology as broad leaf, grass type, sedge and parasitic weeds.

2.3. Estimating Species Abundance, Dominance and Similarity Index

Quantitative measures were calculated for each weed species using the procedures developed by Thomas [13] and Taye and Yohannes [15]. Frequency, usually expressed as a percentage, is the proportion of sampling units that contains the target species [16]. In addition, the abundance, dominance and similarity index was calculated by following formulae;

$$\text{Frequency (\%)} = \frac{\text{number of sampling units in which target species occurred}}{\text{total number of sampling units}} x100$$

$$\text{Abundance} = \frac{\text{sum of individuals of a particular weed species across in all samples}}{\text{total number of samples}}$$

$$\text{Dominance} = \frac{\text{Abundance of the same species}}{\text{Total abundance of all weed species}} * 100$$

$$\text{Similarity index} = 100 * Epg/(Epg + Epa + Epb)$$

Where, Epg= Number of species found in both locations
EPA=Number of species found in location one (“a”)
Epb= Number of species found in location two (“b”)

3. Results and Discussion

The survey results indicated a total of 31 and 32 weed species classified under 13 weed families were identified at Wushwush and Gumero tea plantations, respectively (Tables 1&2). Among the identified weed species 67.8% (at Wushwush) and 71.9% (at Gumero) broad leaf was recorded. Based up on the morphological classification the infestation of sedges and grassy weed type was ranged from 12% to 16% at both locations. *Ageratum conyzoides* (14.9) and *Hydrocotyle americana* (31.3) was abundant tea weed at Wushwush and Gomero, respectively (Tables 3&4). The present result revealed that a similarity index was obtained greater than sixty (>60) i.e., 71.9%. Thus, suggesting that the weed species composition at Wushwush and Gumero tea plantations was similar and indicating that the same control method can be applied for both locations.

3.1. Weed Composition and Diversity at Wushwush

A total of 31 weed species in 12 families were identified at Wushwush tea plantation (Table 1). Based up on their morphology out of 31 weed species recorded at Wushwush 67.5%, 16.1% and 16.1% were broad leaf weeds, grasses and sedges, respectively (Table 1). Asteraceae family had the highest number of weed species 19.35% followed by Poaceae that covers 16.13% the study area.

Table 1. *Family, binomial name, life cycle and morphology of major weed species at Wushwush.*

Family	Scientific name	Common name	Life cycle	Morphology
Asteraceae	*Bidens pilosa*	Black jack	Annual	Broad leaf
	Galinsoga parviflora	Gallant soldier	Annual	Broad leaf
	Ageratum conyzoides	Goat weed	Annual	Broad leaf
	Conyza albida	Asthma weed	Annual	Broad leaf
	Bidens pachyloma	Chuqii (A. O)	Annual	Broad leaf
	Guizotia scabra	Sunflecks	Annual	Broad leaf
Commelinaceae	*Commelina benghalensis*	Tropical spiderwort	perennial	Broad leaf
Convolvulaceae	*Convolvulus arvensis*	Bindweed	Perennial	Broad leaf
	Cuscuta campestries	Dodder	Annual	parasitic
Cyperaceae	*Cyperus rotundus*	Purple nutsedge	Perennial	sedge
	Cyperus esculentus	Yellow nutsedge	Perennial	sedge
	Cyperus cyperiodes	Small flower ubrelasedg	Perennial	sedge
Poaceae	*Kyllinga erecta*	Todiugolo	Perennial	Sedge
		Creeping sedge	Perennial	sedge
Poaceae	*Cynodon dactylon*	Star grass	Perennial	Grass
	Digitaria abyssinica	African coach grass	Perennial	Grass
	Paspalum conjugatum	Bufallo grass	Perennial	Grass
	Cynodon nlemfuensis	African Bermuda grass	Perennial	Grass
	Echinochloa colona	Jungle rice	Perennial	Grass
Portulacaceae	*Portulaca oleracea*	Purslane	Annual	Broad leaf
Solanaceae	*Solanum nigrum*	Black nightshade	Annual	Broad leaf
	Solanum incanum	Bitter apple	Annual	Broad leaf
	Nicandraphysaloides	Apple of peru	Annual	Broad leaf
	Daturastramonium	Thorn apple	Annual	Broad leaf
Plantagnaceae	*Plantago lanceolata*	Narrow leaf plantain	Annual	Broad leaf
	Polygonum arvensis	Smart weed	Annual	Broad leaf
Amarantacea	*Amarantus hybridus*	Green amaranth	Annual	Broad leaf
	Amarantus dubies	Pigweed amaranth	Annual	Broad leaf
Boraginaceae	*Cynoglosum lanciolatum*	Lance leaf	Annual	Broad leaf
Apiaceae	*Hydrocotyle americana*	Indian pennywort	Perennial	Broadleaf
Malvacea	*Corochorus olitorius*	West African sorrel	Annual	Broad leaf

3.2. Weed Composition and Diversity at Gumero

The result revealed that at Gumero a total of 32 weed species in 13 families were identified (Table 2). Among the total of 32 weed species recorded at the surveyed area 71.9% (broad leaf weeds) 15.6% (grasses) and 12.5% (sedges) were respectively. Among recorded weed family Asteraceae had the highest number of weed species (25%) followed by Poaceae family which covers (18.75%) at Gumero too. (Among total 32weed species encountered during the survey period 43.75% were perennial whereas 56.25% annual (Table 2). Cardina *et al.* [9] reported that the floristic diversity and distribution of weeds within the crop fields depends on the cultural practices within the agricultural fields, crop type, tillage systems, soil type, moisture availability, location and season.

Table 2. *Family, Binomial name, Life cycle and Morphology of Major Weed species at Gumero.*

Family	Scientific name	Common Name	Life Cycle	Morphology
Cyperaceae	*Cyprus Cypriodes*	Small flower ubrelasedg	Perennial	sedge
	Cyprus Rotundus	purple nut sedge	Perennial	Sedge
	Kyllinga bulbosa	Spikes edges.	Perennial	Sedge
Polygonaceae	*Polygonum nepalense*	Smartweed	Annual	Broad leaf
	Rumex abyssinicus	Spinach Rhubarb	perennial	Broad leaf
Asteraceae	*Galinsoga parviflora*	Gallant soldier	Annual	Broad leaf
	Bidens pilosa	Black jack	Annual	Broad leaf
	Bidens pachyloma	Chuqii (A. O)	Annual	Broad leaf
	Ageratum conyzoides	Goat weed	Annual	Broad leaf
	Crassocephalum crepidioides	Fireweed (ebolo)	Annual	Broad leaf
	Gyzotia scarab	noog/nug	Annual	Broad leaf
	Xanthium strumarium	Clotbur	Annual	Broad lea
	Coniza albida	Fleabane	Annual	Broad leaf
Commelinaceae	*Commelina benghalensis*	Tropical spiderwort	perennial	Broad leaf
	Commelina subulata	Linear-Leaf Dayflower	Perennial	Broad leaf
Poaceae	*Cynodon spp.*	Bermuda grass	Perennial	Grass
	Paspalum conjugatum	Bufallo grass	Perennial	Gras
	Eleusine indica	Goose grass	perennial	Grass
	Digitaria abyssinica	Couch grass	Perennial	Grass
	Oplismenus hirtellus	bascket grass	Perennial	Grass

Family	Scientific name	Common Name	Life Cycle	Morphology
	Echinochloa colona	Jungle rice	Annual	Grass
Amaranthaceae	*Amaranthus hybridus*	Green amaranth	Annual	Broad leaf
	Amaranthus debius	Pigweed amaranth	Annual	Broad leaf
Plantaginaceae	*Plantago lanciolata*	Narrow leaf plantain	Annual	Broad leaf
Resedaceae	*Caylusia abyssinica*	Aranci	Annual	Broad leaf
	Nicandra physaloides	Apple of peru	Annual	Broad leaf
Solanaceae	*Datura stramonium*	Jimson weed	Annual	Broad leaf
	Solanum nigrum	Black nightshade	Annual	Broad leaf
Convolvuaceae	*Convoluleus arvensis*	Bindweed	Perennial	Broad leaf
Aizoaceae	*Zaleya pentandra*	African purslane	Perennial	Broadleaf
Araliaceae	*Hydrocotyle Americana*	Indian pennywort	Perennial	Broad leaf
Acanthaceae	*Hygrophila Auriculata*	Marsh Barbell	Annual	Broad leaf

3.3. Species Frequency, Abundance and Dominance at Wushwush Tea Plantation

The result revealed that *Hydrocotyle americana, Ageratum conyzoides, and Commelina benghalensis,* were the most frequently recorded weed species at Wushwush tea plantation with 77.2, 77.2, and 74.3% frequency, respectively (Table 3). Based on the frequency, abundance and dominance values the top six weed species were *Hydrocotyle americana, Ageratum conyzoides, Commelina benghalensis, Galinsoga parviflora, Cyperus cyperiodes, and Cyperus bulbosus*. *Ageratum conyzoides* was ranked first with a high frequency (72.2), abundance (14.9) and dominance (24.2) value followed by *Hydrocotyle americana* with frequency value of 77.2, abundance value of 16.9 and dominance value of 23.0 compared with the other weed species available in the surveyed tea farms (Table 3).

Table 3. *Frequency, Abundance and Dominance of Major Weeds Species at Wushwush Tea Plantation.*

Species	Frequency (%)	Abundance	Dominance
Ageratum conyzoides	77.2	14.9	24.2
Amaranthus dubius	14.3	0.8	1.3
Amaranthus hybrids	11.4	0.7	1.2
Bidens pilosa	37.2	1.2	2
Bidens polychyma	11.4	0.7	1.1
Commelina benghalensis	74.3	10.1	16.4
Convolvulus arvensis	2.9	0.4	0.65
Conyza albida	5.7	0.3	0.5
Corchorus olitorius	5.7	0.1	0.2
Cynodon spp	11.4	2	3.25
Cynoglossum lanceolatum	14.3	0.3	0.5
Cyperus cyperoides	28.6	2.9	4.7
Cyperus erectus	28.6	2.5	4.1
Cyperus esculentus	5.7	0.1	0.2
Cyperus rotundus	5.7	0.2	0.3
Datura stramonium	2.9	0.6	1
Digitaria abyssinica	5.7	0.3	0.5
Echinochloa colona spp	5.7	0.3	0.5
Galinsoga parviflora	57.2	4.8	7.8
Guizotia abyssinica	2.9	0.3	0.5
Hydrocotyle american	77.2	14.2	23.1
Nicandra physalodes	2.9	0.1	0.2
Paspalum conjugatum	2.9	0.1	0.2
Plantago lanceolata	11.4	0.8	1.3
Polygonum spp	34.3	2	3.3
Portulaca oleracea	5.7	0.4	0.7
Solanum incanum	2.9	0.3	0.5
Solanum nigrum	2.9	0.1	0.2
Xanthium strumarium	2.9	0.1	0.2

3.4. Weed Species Frequency, Abundance and Dominance at Gumaro Tea Plantation

The result revealed that out of 32 weed species recorded in Gumero tea plantation *Ageratum conyzoides* and *Commelina benghalensis* were the most frequent weed Species at Gumero tea plantation with 80% and 75% frequency (Table 4). Based on the frequency, abundance and dominance values the top three weed species were*, Ageratum conyzoides*, *Commelina benghalensis* and *Bidens pilosa*. *Ageratum conyzoides* was ranked first with a high frequency (80), abundance (19.1) and dominance (19.36) value followed by *Commelina benghalensis* with frequency value of (75), abundance value of (16.2) and dominance value of (16.43)

compared with the other weed species available in the surveyed tea farms (Table 4).

Table 4. *Frequency, Abundance and Dominance of Major Weeds Species at Gumero tea plantation.*

Species	Frequency (%)	Abundance	Dominance
Cyprus cypriodes	5	1.3	1.31
Cyprus rotundus	5	0.2	0.25
Kyllinga bulbosa	25	4.1	4.2
Polygonum nepalense	45	14.1	14.3
Galinsoga parviflora	5	0.7	0.7
Biden spilosa	55	7.7	7.8
Bidens pachyloma	5	0.1	0.1
Ageratum conyzoides	80	19.1	19.36
Commelina benghalensis	75	16.2	16.43
Commelina subulata	10	0.05	0.05
Crassocephalum crepidioides	10	2.7	2.7
Hydrocotyle Americana	45	31.3	31.7
Cynodon spp.	5	0.1	0.1
Datura stramonium	5	0.2	0.2
Echinocloa colona	5	0.2	0.2
Solanum nigrum	5	0.15	0.15
Amaranthus hybridus	5	0.15	0.15
Amaranthus debius	5	0.25	0.25
Plantago laneolata	5	0.5	0.5
Caylusiaabyssinica	5	0.25	0.25
Coniza albida	15	0.9	0.97
Rumex abyssinicus	5	0.1	0.1
Hygrophila auriculata	5	0.15	0.15

3.5. Similarity Index

The result of data recorded on similarity index showed that weed species composition of two locations was similar. This might be because of the similarity in soil, environmental conditions and cultural practices between the locations. Study indicated that variations in species composition between fields were associated with human management factors, the current crop type and the preceding crop type [17]. Lososová *et al.* [18] reported that major changes in weed species composition were associated with a complex gradient of increasing altitude and precipitation and decreasing temperature and base status of the soils.

The similarity index value of Wushwush and Gumero tea plantations was 71.9% (i.e., >60%) which implies that if the similarity index is > 60%, it is assumed that the two locations are similar in species composition [15]. Hence, the same control method can be applied to the study locations. Therefore, present result revealed a similarity index value (71.9%) suggesting that the species composition of Wushwush and Gumero tea plantations are similar and similar weed management methods will be recommended for both locations.

Table 5. *Similarity index of weed species at Wushwush and Gumero tea plantation.*

Location	Wushwush	Gumero
Wushwush	100	71.43
Gumero	71.43	100

4. Conclusion and Recommendation

Current study was provides basic information of weed flora composition of tea plantation in southwest of Ethiopia that focused on identification of weed species and determination of their frequency, abundance, dominance and similarity index. In present survey total 17 major weed families contains different individual weed species with varied with level of frequency, abundance and dominance were recorded and identified. Among recorded weed family Asteraceae and Poaceae were the most dominant families in terms of occurrence and species number. Based up on the similarity index both tea plantations have more or less similar weed flora composition. This has far reaching implication that similar weed management methods can be recommended for both tea plantations. Therefore, further study will be conducted to identify, determine, quantify yield losses and document the weed flora dynamics and their possible impacts on tea production and productivity in Ethiopia by using large sampling size at large scale.

Acknowledgements

The authors would like to express their thanks to Ethiopian Institute of Agricultural Research (EIAR), Jimma Agricultural Research center for providing logistics and vehicle support during the survey and also to Wushwush and Gumaro tea plantation company for availing the plot, their time and effort in taking part in provided information during survey period.

References

[1] Concenco G, Silva CJ, Correia IV, Silva JA, Santos SA, Froes AL, et al. 2014. Occurrence of weed species in *Jatropha curcas* intercropping systems. Planta Daninha. 32 (2): 327-334.

[2] Romaneckien˙ e, R.; Pilipavi˘cius, V.; Romaneckas, K. 2008. Weed emergence and death in the crop of spring barley of different competitive ability. Vagos, 15, 17–24, (In Lithuanian with English summary).

[3] Deka, J, Barua I 2015. Weed of tea field and therir control. In National Seminar on plant protection in Tea, Tea research Association, Tocklai Tea Research Institute India pp 55-56.

[4] Firehun Y. and Tamado T. 2007. Qualitative and Quantitative Assessment of Weeds in the Sugarcane Plantations of Wonji-Shewa and Matahara. *Eth. J. of Weed Mgt*. 1: 1-14.

[5] Aruna Varanasi, P. V. Vara Prasad, MithilaJugulam. 2016. Impact of Climate Change Factors on Weeds and herbicide Efficacy. Pp. 109-1222. *In*. Donald L. Sparks (eds.), Advances in Agronomy. Elsevier Inc.

[6] Bhagirath S. Chauhan and Gurjeet S. Gill. 2014. Ecologically Based Weed Management Strategies. Pp. 1. *In*: B. S. Chauhan, G. Mahajan (eds.), *Recent Advances in Weed Management.* Springer Science Business Media New York.

[7] Barberi, P.; Cascio Lo, B. Long-term tillage and crop rotation effects and weed seed bank size and composition. Weed Res. 2001, 41, 325–340.

[8] Kropff. M. J and Stipper C. J. T. 1991. Use of Ecophysiological Models for Crop-Weed Interference: Relations amongst Weed Density, Relative Time of Weed Emergence, Relative Leaf Area, and Yield Loss.

[9] Cardina, J.; Herms, C. P.; Doohan, D. J. Crop rotation and tillage system effects on weed seedbanks. Weed Sci. 2002, 50, 448–460.

[10] Terzioğlu, S. A. L. İ. H. and Bozkurt, A. E., 2020. The Weed Flora of Turkish Tea Plantations. *Gümüşhane Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *10* (3), pp. 621-630.

[11] Negasu G., Rezene F. and Taye T. 2012. Assessment of Weed Flora Associated to Wheat and Barley at Jibat and Tikur Inchini Districts. *Eth. J. of Weed Mgt*. 5: 39-50.

[12] Addisu M. 2008. Production and Marketing of Tea in Ethiopia. *In*: Girma, A., Bayetta, B., Tesfaye, S. Endale, T., and Taye, K. eds. Coffee diversity and knowledge, Proceedings of a National Workshop Four Decades of Coffee Research and Development in Ethiopia, 14-17 August 2007, Addis Ababa, Ethiopia, pp. 465-471.

[13] Thomas AG. 1985. Weed survey system in Saskatchewean for cereal and oil seed crops. Weed Science 33: 34-43.

[14] Stroud A and Parker. 1989. A weed identification guide for Ethiopia. FAO, Rome.

[15] Taye T. and Yohhaness L. 1998. Quantitative and qualitative determination of weeds in tef in west Shoa Zone. Arem 4: 46-60.

[16] Booth, B. D., Murphy, S. D., and Swanton, C. J. (2003). Weed Ecology in Natural and Agricultural Systems. Wallingford, CT: CABI Publishing.

[17] Fried, G., Norton, L. R. and Reboud, X., 2008. Environmental and management factors determining weed species composition and diversity in France. *Agriculture, ecosystems & environment*, *128* (1-2), pp. 68-76.

[18] Lososová, Z., Chytrý, M., Cimalová, S., Kropáč, Z., Otýpková, Z., Pyšek, P. and Tichý, L., 2004. Weed vegetation of arable land in Central Europe: Gradients of diversity and species composition. *Journal of Vegetation Science*, *15* (3), pp. 415-422.