



RESEARCH ARTICLE

Assessment of weed species composition and diversity in tomato (*Solanum lycopersicum* L.) farms in Ethiopia

[version 1; peer review: 1 not approved]

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Abstract

Background: Weeds compete for vital nutrients and water with the tomato plants and serve as an alternative host for other pests. Although there is limited information on the weed species composition in major tomato-growing areas in Ethiopia, this study was conducted to identify the economically important weed species in tomato fields in the East Wollega, Shewa, West Shewa, Arsi, and Sidama zones.

Methods: The weed flora assessment was conducted in major tomato growing zones of the country, such as East Shewa, Wollega, West Shewa, Arsi, and Sidama zones, in the 2018–2019 cropping season during the off-season. In each tomato field a 1 m x 1 m quadrat was thrown following an inverted X pattern, and weed species were recorded. Weed species composition was calculated using standard formulas.

Results: The results revealed that 63 weed species under 23 families were identified at the surveyed locations. *Portulaca oleracea* was the most abundant and dominant, with 50% of the dominance value. Weed frequency values ranged from 0.06 to 72% in the studied areas. The weed similarity index was also different among the surveyed locations. The results of farmers perceptions on weed management in tomato fields showed that 61% of respondents practiced hoeing followed by hand weeding, and *Tuta absoluta* was the most significant constraint to tomato production in the surveyed areas.

Conclusions: This assessment showed that there are differences in the composition and distribution of weed species in tomato fields in Ethiopia, which aid in predicting the population dynamics of weed flora. Farmers perceptions of weed management practices in tomato fields were also different. Therefore, different environmentally friendly weed management options such as good crop husbandry, biological control, and integrated management should be designed to increase tomato production and productivity.

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1

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[view](#)

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

Abundance, Dominance, Portulaca oleracea, Weed species



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Introduction

The tomato is one of the most extensively grown vegetable crops in Ethiopia, ranking 8th in terms of annual national production (Tasisa *et al.*, 2012). Nevertheless, in Ethiopia, the yield of tomato is 8 tons per hectare, which is lower than other tomato-producing countries, which produce 34 tons per hectare (FAOSTAT, 2012).

The increase in agricultural pests is one of the major constraints on vegetable production and productivity in Ethiopia, particularly in the mid-Rift Valley. Weeds compete with the host plant for vital nutrients and available space, resulting in decreased yields in both quantity and quality (Reddy and Reddy, 2019; Kebede *et al.*, 2017). Even though most farmers give less attention to the impact of weeds, a study shows that 45% of annual losses of agricultural products are caused by weeds (Terfa, 2018).

Weeds are currently complicating pest issues to a great extent. The increasing prevalence of numerous viral diseases in tomatoes further highlights the significance of weed control because they may serve as alternative hosts and raise production costs (Hanzlik and Gerowitt, 2016).

The success of plant protection initiatives depends on the capacity to identify pests (Kalaris *et al.*, 2014). Crop weed flora varies throughout habitats and fields based on the weather, irrigation, fertilizer use, soil type, weed management methods, and cropping patterns (Anderson and Beck, 2007; Kebede *et al.*, 2017).

In a particular agro-ecology, weed flora assessment aids in the prediction of changes in weed populations brought on by climate change, agricultural practices, and pesticide resistance. In Ethiopia, there is limited information and no well-documented weed species composition and distribution that explain the reduction in tomato production and productivity. The proper identification and prioritization of the most economically significant weed species is essential for solving this issue and aids in the development of effective weed control measures. This supports the claim that accurate information on the presence, composition, importance, and ranking of weed species is required in order to develop effective weed management approaches (Migwi *et al.*, 2017). Similar research has demonstrated that it is possible to determine from survey data the local, regional, and national relevance of weed species and the functions they perform (Hanzlik and Gerowitt, 2016).

On the other side, weed flora identification aids in maintaining the natural enemies of crop pests and maintaining the balance between crop and non-crop vegetation (Terfa, 2018). This study was carried out to evaluate, catalog, and rank the most economically significant weed species in Ethiopia's main tomato-growing regions.

Methods

Ethical considerations

This study was approved by the review committee of the Ethiopian Institute of Agricultural Research, Ambo Agricultural Research Center, Ambo, Ethiopia. Ethical approval was obtained from review committee on January 10, 2018, before the implementation of the study. Verbal consent was obtained from participants through interviewing because all respondents were illiterate.

Description of study areas

The weed survey was conducted at major tomato-growing areas of the country (Table 1), such as East Shewa, Wollega, West Shewa, Arsi, and Sidama zones, in the 2018–2019 cropping season during the off-season (Figure 1).

Table 1. Weed surveyed locations in major tomato growing areas in Ethiopia.

Region	Zone	Name of districts	Number of kebele	Number of fields assessed	Altitude ranges m a.s. l
Oromia	West Arsi	Dodeta	2	4	1525–1540
Oromia	East Shewa	Bora, Dugda, Adami Jido Kombolcha	7	9	1583–1669
Oromia	West Shewa	Toke-kutaye, Ilu Galan, Bako Tibe, Ambo	9	11	2280–1627
Oromia	East Wollega	Gobu-Sayo, Sibru Sire, Wayu Tuka	9	10	1618–1797
Sidama	Sidama	Hawasa zuria	4	5	1680–1688

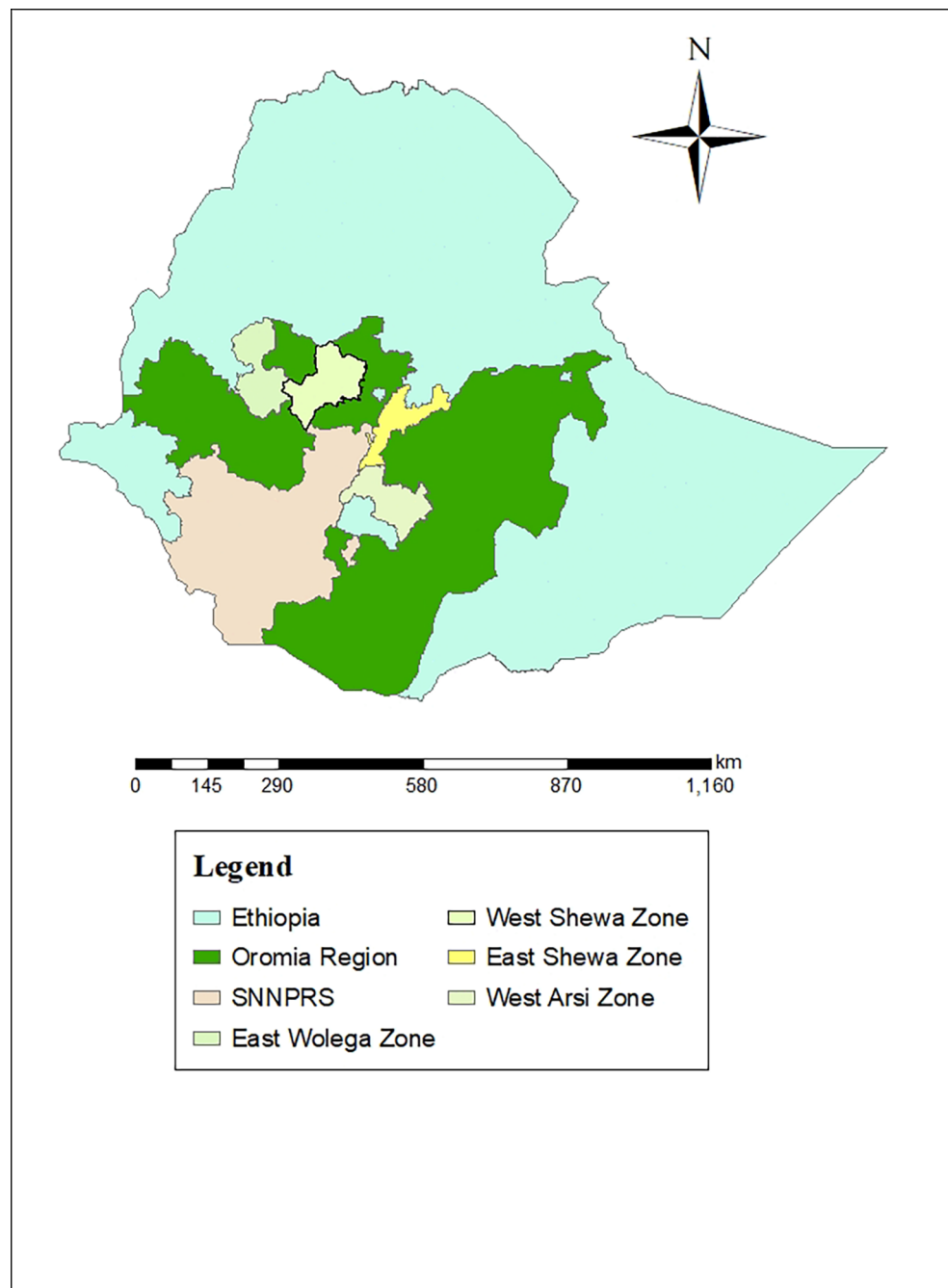


Figure 1. Map of weed flora surveyed areas in major tomato growing zones.

Weed species sampling techniques

Weed assessment was done at 5–10 km intervals on the main roadside and gravel roads of major tomato growing areas. In each field, a 1 m × 1 m quadrat was used, following an inverted X pattern.

A quadrat was randomly thrown along transects in each field, and the weed types and extent in a quadrat were recorded according to the methodology (Thomas, 1985; Kevine McCully *et al.*, 1991). The first quadrat sample was taken following where the surveyor walks 50 paces along the edge of the field, turns right and walks 50 paces into the field, throws the quadrat, and starts taking the sample. A new specimen that was difficult to distinguish was brought to the Ambo Agricultural Research Center (Ambo ARC) and identified by experienced researchers using identification manuals. The Global Positioning System (GPS) coordinates of the sampling points were also collected. About 39 tomato fields and 195 weed samples were taken in the studied areas.

The nomenclature of weed flora was done by using the flora of Ethiopia and Eritrea as a weed identification guide (Stroud and Parker, 1989). Information on cropping systems, crop varieties used, crop management practices, adopted weed control methods, and herbicide use history was collected simultaneously during weed flora assessment from farmers and other tomato growers through interviews (Dereje, 2023b). At each surveyed site, 2–3 voluntary respondents were randomly selected and interviewed.

Field data on weed species composition and similarity index (SI) were collected at every sampling point. At each site of data collection, weed species were recorded on a data sheet and later weed species composition (frequency, abundance and dominance) and similarity index was calculated using standard formulas.

Data analysis

Data on weed species was summarized using the formula described by Tessema *et al.* (1999) and Thomas (1985).

Frequency: is the percentage of sampling plots in which a particular weed species is found in a field. It explains how often a weed species occurs in the survey area (Marshall, 1988).

$$F = \frac{100 * X}{N}$$

Where, F = Frequency of particular weed species, X = number of samples in which a particular weed species occurs, N = total number of samples.

Abundance: is the population density of a weed species expressed as the number of individuals of weed plants per unit area (Tessema *et al.*, 1999).

$$A = \frac{\sum W}{N}$$

Where, A = Abundance, $\sum W$ = Sum of individuals of a particular weed species across all samples, N = total number of samples in a field.

Dominance: abundance of an individual weed species in relation to total weed abundance in a field (Thomas, 1985; Tessema *et al.*, 1999).

$$D = \frac{A * 100}{\sum W}$$

Where, D = Dominance of a particular species, A = Abundance of the same species, $\sum W$ = Total abundance of all weed species.

Similarity index (community index): is the similarity of weed communities between different locations or crops. If the index of similarity is >60%, it is assumed that the two locations are similar in species composition and hence the same control method can be applied (Tessema *et al.*, 1999).

$$SI = \frac{E_{pg}}{E_{pg} + E_{pa} + E_{pb}} \times 100$$

Where, SI = Similarity index; E_{pg} = number of species found in both locations; E_{pa} = number of species found in location I; E_{pb} = number of species found in locations II.

Data on the farmers perceptions of weed management practices in tomato fields were calculated through descriptive statistics using Statistical Package for Social Sciences (SPSS) (RRID:SCR_002865) version 26.

Results and discussion

Classification of weed species in tomato fields

A field survey on weed species in major tomato growing areas showed that 63 weed species from 23 families were identified in the surveyed areas (Dereje, 2023a). Based on number of taxa, the *Asteraceae* family contained 13 weed species, followed by the *Poaceae* family with 11 weed species (Table 2). Among weed species, 50 of them were categorized as broad-leaved, whereas 13 were classified as grasses and sedges.

Table 2. Weed species categories and their morphology in the major tomato growing areas of East Shewa, Wollega, West Shewa, Arsi, and Sidama zones.

Family name	Scientific name	Common name	Morphology	Life form
Asteraceae	<i>Galinsoga parviflora</i> Cav.	Gallant-soldiers	broad leaf	Annual
	<i>Parthinum hyStrophorous</i> L.	Ragweed parthenium	broad leaf	Annual
	<i>Sonchus oleraceus</i> L.	Milk thistle	broad leaf	Annual
	<i>Xanthium strumarium</i> L.	Large cocklebur	broad leaf	Annual
	<i>Sonchus asper</i> (L.) Hill.	Rough milk thistle	broad leaf	Annual
	<i>Bideance Pilosa</i> L.	Hairy beggar ticks	broad leaf	Annual
	<i>Sonchus arvensis</i> L.	Sow thistle	broad leaf	Perennial
	<i>Guizotia scabra</i> (Vis.) Chiov.	Sun flecks	broad leaf	Annual
	<i>Spilanthes mauritiana</i> (Rich. ex Pers.) DC.	Toothache Plant	broad leaf	Annual
	<i>Gnaphalium Unionis</i> Sch. Bip. ex Hochst.	Cudweeds	broad leaf	Annual
	<i>Ageratum houstonianum</i> Mill.	Blue mink	broad leaf	Annual
	<i>Carduus pycnocephalus</i> L.	Italian thistle	broad leaf	Perennial
	<i>Xanthium spinosum</i> L.	Prickly Burweed	broad leaf	Annual
Poaceae	<i>Eluesina indica</i> (L.) Gaertn.	Silver Crabgrass	grass	Annual
	<i>Setaria pumila</i> (Poir.) Roem. &Schult.	Yellow foxtail	grass	Annual
	<i>Cynadon dactylon</i> L.	Bermuda grass	grass	Perennial
	<i>Oplismenus hirtellus</i> (L.) P. Beauv.	Basket grass	grass	Perennial
	<i>Eichcnocola colona</i> (L.) Link	Jungle rice	grass	Annual
	<i>Snowdenia species</i>	-	grass	Annual
	<i>Digetaria abbysinica</i> (Hochst. ex A. Rich.) Stapf (Afr.)	East African couch grass	grass	Perennial
	<i>Snowdenia polystachya</i> (Fresen.) Pilg.	Ethiopian grass	grass	Annual
	<i>Digitaria species</i>	Crabgrass	grass	Perennial
	<i>Phalaris paradoxa</i> L.	Annual canary grass	grass	Annual
	<i>Digeteria ternata</i> (A. Rich.) Stapf	Black-seed finger grass	grass	Annual
Cyperaceae	<i>Cyperus rotundus</i> L.	Purple Nutsedge	sedges	Perennial
	<i>Cyperus assimilis</i> Steud.	-	sedges	Annual
Amaranthaceae	<i>Amaranth hybridus</i> L.	Smooth pigweed	broad leaf	Perennial
	<i>Amaranths spoinotisus</i> L.	spiny amaranth	broad leaf	Annual
	<i>Amaranth species</i>	Pigweed	broad leaf	Perennial
	<i>Chenopodium species</i>	Wild spinach	broad leaf	Annual
	<i>Chenopodium procerum</i> (Hochst ex.) Moq.	Bacan weed	broad leaf	Annual
Fabaceae	<i>Vicia species</i>	Vetches	broad leaf	Annual
	<i>Trifolium rueppellianum</i> Fresen.	Clover	broad leaf	Annual
	<i>Sinapis arvensis</i> L.	Wild mustard	broad leaf	Annual
	<i>Medicago polymorpha</i> L.	Toothed bur clover	broad leaf	Annual

Table 2. Continued

Family name	Scientific name	Common name	Morphology	Life form
Commelinaceae	<i>Commelina latifolia</i> Hochst. ex A.Rich.	Dayflower	broad leaf	Perennial
	<i>Commelina benghalensis</i> L.	Benghal dayflower	broad leaf	Annual or Perennial
	<i>Cyanotis cristata</i> (L.) D. Don	Crested dew-grass	broad leaf	Annual or Perennial
	<i>Cyanotis barbata</i> D. Don.	-	broad leaf	Perennial
Solanaceae	<i>Datura stramonium</i> L.	Thorn apple	broad leaf	Annual
	<i>Solanum nigrum</i> L.	Black nightshade	broad leaf	Perennial
	<i>Nicandra physalodes</i> Scop.	Shoot fly-plant	broad leaf	Annual
Convolvulaceae	<i>Convolvulus arvensis</i> L.	Field bindweed	broad leaf	Perennial
	<i>Convolvulus species</i>	-	broad leaf	Perennial
	<i>Ipomoea purpurea</i> (L.) Roth	Morning glory	broad leaf	Annual
Polygonaceae	<i>Polygonum aviculare</i> L.	Prostrate knotweed	broad leaf	Annual
	<i>Persicaria nepalense</i> Meisn.) H.Gross	Nepal persicaria	broad leaf	Annual
Caryophyllaceae	<i>Spergulla arvensis</i> L.	Stick wort	broad leaf	Annual
	<i>Corrigiola capensis</i> Willd.	Strap worts	broad leaf	Annual
Lamiaceae	<i>Leucas martinicensis</i> (Jacq. Ait.f.)	Cobbin weed	broad leaf	Perennial
	<i>Leucas species</i>	-	broad leaf	Perennial
Primulaceae	<i>Anagallis arvensis</i> L.	Poor man's weatherglass	broad leaf	Annual
Euphorbiaceae	<i>Euphorbia hirta</i> L.	Asthma weed	broad leaf	Annual
Portulacaceae	<i>Portulaca oleracea</i> L.	Common purslane	broad leaf	Annual
Oxalidaceae	<i>Oxalis latifolia</i> Kunth.	Broadleaf wood sorrel	broad leaf	Perennial
Papaveraceae	<i>Argemone ochroleuca</i> L.	Sweet poppy	broad leaf	Annual
Zygophyllaceae	<i>Tribulus terrestris</i> L.	Puncture vine	broad leaf	Annual
Nymphaeaceae	<i>Nymphaea odorata</i> Aiton	Fragrant Water-Lily	broad leaf	Aquatic
Plantaginaceae	<i>Plantago lanceolata</i> L.	Ribwort plantain	broad leaf	Perennial
Resedaceae	<i>Cayusea abyssinica</i> (Fresn.) Fish & Mey	Cultivated flowering plant	broad leaf	Annual
Brassicaceae	<i>Erucastrum arabicum</i> Fisch. & C.A. Mey	Brassica schimper Boiss	broad leaf	Annual
Orobanchaceae	<i>Orobancha crenata</i> L.	Bean broomrape	parasite	Annual
Malvaceae	<i>Hibiscus trionum</i> L.	Flower-of-an-hour	broad leaf	Annual

Weed species composition and distribution

Portulaca oleracea and *Cyperus rotundus* were the most dominant weed species in East Shewa and West Arsi, with 50 and 47.25%, respectively (Tables 3 and 4). The lowest weed species dominance was obtained by *Sonchus asper* at East Shewa, *Bideance pilosa* at East and West Shewa (Table 3), *Oplismenus hirtellus*, *Sonchus oleraceus*, and *Setaria pumila* at Sidama Zones.

The highest weed frequency was also recorded by *Portulaca oleracea* (95%) and *Cyperus rotundus* (70%) in the West Arsi Zone (Table 4). A similar finding reported that *Cyperus* species, *Portulaca oleracea*, and *Amaranth* species were the most frequent weed species at Rift Valley areas in the country (Firehun and Tamado, 2006).

Table 3. Weed species composition in major tomato growing areas of West Shewa, East Wollega, and Shewa zones in 2019.

Weed species	West Shewa			East Wollega			East Shewa		
	F	A	D	F	A	D	F	A	D
<i>Galinsoga parviflora</i>	54.00	11.8	16.63	56.00	10.48	14.84	15.55	2.35	3.23
<i>Cyperus rotundus</i>	44.00	3.12	4.39	70.00	16.7	23.64	73.33	12.97	17.80
<i>Eluesina indica</i>	14.00	0.32	0.45	4.00	0.06	0.08	37.77	4.38	6.00
<i>Datura stramonium</i>	36.00	6.8	9.59	44.00	7.28	10.31	35.55	1.93	2.65
<i>Setaria pumila</i>	28.00	0.96	1.35	34.00	1.04	1.47	33.33	2.20	3.01
<i>Parthinum hyStrophorous</i>	2.00	0.04	0.06	0.00	0.00	0.00	0.00	0.00	0.00
<i>Portulaca oleracea</i>	14.00	0.88	1.24	0.00	0.00	0.00	46.67	36.44	50.01
<i>Cynadon dactylon</i>	42.00	3.9	5.49	40.00	2.36	3.34	15.55	0.47	0.64
<i>Oplismenus hirtellus</i>	6.00	0.08	0.11	14.00	0.22	0.31	8.88	0.20	0.27
<i>Amaranth hybridus</i>	40.00	3.52	4.96	18.00	0.72	1.02	48.88	3.29	4.51
<i>Xanthium strumarium</i>	34.00	2.22	3.12	12.00	0.42	0.59	31.11	2.89	3.96
<i>Hibiscus trionum</i>	6.00	0.08	0.11	0.00	0.00	0.00	6.66	0.31	0.42
<i>Oxalis latifolia</i>	10.00	0.9	1.27	14.00	2.16	3.06	0.00	0.00	0.00
<i>Amaranth species</i>	14.00	1.82	2.56	30.00	5.04	7.13	0.00	0.00	0.00
<i>Eichcnocola colona</i>	10.00	0.26	0.37	0.00	0.00	0.00	4.44	0.15	0.21
<i>Persicaria nepalense</i>	2.00	0.02	0.02	6.00	0.08	0.11	8.88	0.18	0.24
<i>Commelina latifolia</i>	34.00	1.38	1.94	48.00	1.58	2.23	31.11	1.20	1.64
<i>Bideance Pilosa</i>	2.00	0.02	0.03	30.00	6.5	9.20	2.22	0.02	0.03
<i>Digetaria abbyssinica</i>	18.00	0.98	1.38	4.00	0.12	0.17	0.00	0.00	0.00
<i>Digitaria species</i>	14.00	0.46	0.64	0.00	0.00	0.00	0.00	0.00	0.00
<i>Phalaris paradoxa</i>	8.00	1.00	1.41	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cyanotis barbata</i>	2.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
<i>Nymphaea odorata</i>	14.00	0.80	1.12	0.00	0.00	0.00	0.00	0.00	0.00
<i>Sonchus oleraceus</i>	6.00	0.14	0.19	20.00	1.02	1.44	0.00	0.00	0.00
<i>Chenopodium album</i>	8.00	0.52	0.73	4.00	0.10	0.14	0.00	0.00	0.00
<i>Plantago lanceolata</i>	16.00	1.08	1.52	10.00	0.42	0.59	0.00	0.00	0.00
<i>Corrigiolia capensis</i>	18.00	1.48	2.09	24.00	0.82	1.16	0.00	0.00	0.00
<i>Spergulla arvensis</i>	8.00	0.14	0.19	32.00	1.40	1.98	0.00	0.00	0.00
<i>Guizotia scabra</i>	28.00	0.56	0.79	30.00	1.40	1.98	0.00	0.00	0.00
<i>Cyanotis cristata</i>	8.00	0.16	0.22	0.00	0.00	0.00	0.00	0.00	0.00
<i>Spilanthes mauritiana</i>	4.00	0.06	0.08	0.00	0.00	0.00	0.00	0.00	0.00
<i>Caylusea abbyssinica</i>	22.00	0.52	0.73	26.00	0.92	1.30	0.00	0.00	0.00
<i>Commelina benghalensis</i>	4.00	0.06	0.08	8.00	0.20	0.28	0.00	0.00	0.00
<i>Sinapis arvensis</i>	14.00	0.48	0.77	6.00	0.14	0.19	0.00	0.00	0.00
<i>Medicago polymorpha</i>	22.00	0.34	0.48	32.00	1.46	2.07	0.00	0.00	0.00
<i>Nicandra physalodes</i>	16.00	0.24	0.33	46.00	2.02	2.86	0.00	0.00	0.00
<i>Leucas martinicensis</i>	10.00	0.14	0.19	0.00	0.00	0.00	0.00	0.00	0.00
<i>Gnaphalium Unionis</i>	18.00	0.70	0.98	0.00	0.00	0.00	0.00	0.00	0.00
<i>Anagallis arvensis</i>	8.00	0.08	0.11	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ageratum houstonianum</i>	10.00	1.12	1.58	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carduus pycnocephalus</i>	4.00	0.04	0.06	6.00	0.14	0.19	0.00	0.00	0.00

Table 3. Continued

Weed species	West Shewa			East Wollega			East Shewa		
	F	A	D	F	A	D	F	A	D
<i>Erucastrum arabicum</i>	2.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
<i>Digeteria ternata</i>	4.00	0.06	0.08	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cyperus assimilis</i>	10.00	20.76	29.26	0.00	0.00	0.00	0.00	0.00	0.00
<i>Convolvulus arvensis</i>	2.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
<i>Xanthium spinosum</i>	6.00	0.12	0.17	0.00	0.00	0.00	0.00	0.00	0.00
<i>Orobancha crenata</i>	2.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
<i>Convolvulus species</i>	8.00	0.7	0.99	0.00	0.00	0.00	0.00	0.00	0.00
<i>Vicia species</i>	0.00	0.00	0.00	24.00	0.46	0.65	6.66	0.29	0.39
<i>Argemone ochroleuca</i>	0.00	0.00	0.00	4.00	0.10	0.14	8.88	0.20	0.27
<i>Sonchus asper</i>	0.00	0.00	0.00	2.00	0.06	0.08	2.22	0.02	0.03
<i>Tribulus terrestris</i>	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.09	0.12
<i>Ipomoea purpurea</i>	0.00	0.00	0.00	0.00	0.00	0.00	24.44	1.22	1.77
<i>Snowdenia species</i>	0.00	0.00	0.00	2.00	0.02	0.02	11.11	0.37	0.51
<i>Solanum nigrum</i>	0.00	0.00	0.00	8.00	0.26	0.37	20.00	1.35	1.38
<i>Amaranthus spinoletus</i>	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.31	0.42
<i>Euphorbia hirta</i>	0.00	0.00	0.00	18.00	2.62	3.71	0.00	0.00	0.00
<i>Leucas species</i>	0.00	0.00	0.00	4.00	0.08	0.11	0.00	0.00	0.00
<i>Trifolium rueppellianum</i>	0.00	0.00	0.00	20.00	0.94	1.33	0.00	0.00	0.00

Note: F = Frequency; A = Abundance; D = Dominance.

Table 4. Weed species composition in tomato fields in the West Arsi and Sidama zones in 2019.

Weed species	West Arsi			Sidama		
	F	A	D	F	A	D
<i>Galinsoga parviflora</i>	60.00	2.30	4.51	68.00	12.04	19.59
<i>Cyperus rotundus</i>	70.00	24.10	47.25	24.00	9.24	15.03
<i>Eluesina indica</i>	20.00	0.45	0.88	28.00	1.76	2.86
<i>Datura stramonium</i>	15.00	0.30	0.58	28.00	5.52	8.98
<i>Setaria pumila</i>	45.00	1.30	2.54	4.00	0.04	0.06
<i>Sonchus oleraceus</i>	5.00	0.05	0.09	4.00	0.04	0.06
<i>Portulaca oleracea</i>	95.00	16.05	31.47	72.00	15.92	25.91
<i>Cynodon dactylon</i>	5.00	0.25	0.49	28.00	1.56	2.53
<i>Oplismenus hirtellus</i>	40.00	0.8	1.56	4.00	0.04	0.06
<i>Amaranth hybridus</i>	15.00	0.25	0.49	32.00	1.48	2.40
<i>Oxalis latifolia</i>	0.00	0.00	0.00	8.00	0.16	0.26
<i>Argemone mexicana</i>	0.00	0.00	0.00	8.00	0.12	0.19
<i>Amaranth species</i>	15.00	0.15	0.29	40.00	1.68	2.73
<i>Tribulus terrestris</i>	0.00	0.00	0.00	16.00	1.48	2.40
<i>Solanum nigrum</i>	0.00	0.00	0.00	44.00	4.08	6.64
<i>Commelina latifolia</i>	0.00	0.00	0.00	40.00	1.56	2.53
<i>Amaranthus spinoletus</i>	0.00	0.00	0.00	4.00	0.08	0.13
<i>Bideance pilosa</i>	0.00	0.00	0.00	8.00	0.08	0.13

Table 4. Continued

Weed species	West Arsi			Sidama		
	F	A	D	F	A	D
<i>Digetaria abyssinica</i>	0.00	0.00	0.00	16.00	0.36	0.58
<i>Chenopodium species</i>	0.00	0.00	0.00	8.00	0.28	0.45
<i>Euphorbia hirta</i>	70.00	2.75	5.39	0.00	0.00	0.00
<i>Leucas species</i>	0.00	0.00	0.00	32.00	2.16	3.51
<i>Xanthium strumarium</i>	15.00	0.15	0.29	0.00	0.00	0.00
<i>Parthinum hyStrophorous</i>	35.00	1.70	3.33	0.00	0.00	0.00
<i>Digitaria species</i>	0.00	0.00	0.00	12.00	1.76	2.86

Note: F = Frequency; A = Abundance; D = Dominance.

Table 5. Similarity index of tomato weed species among surveyed zones.

Location	West Shewa	East Wollega	West Arsi	East Shewa	Sidama
West Shewa	100				
East Wollega	54.56	100			
West Arsi	28.57	30	100		
East Shewa	32.6	58.62	42.30	100	
Sidama	30.36	46.15	42.30	44.44	100

Similarity index of weed flora

The result revealed that the highest weed community index was obtained between East Shewa and Wollega zones, with 58.62% similarity (Table 5). Whereas the lowest weed species similarity index value (28.57) was registered between West Shewa and Arsi zones.

This diversity and distributions in weed species composition may be due to variation in climatic conditions, soil types, and farmer practices (Saavedra *et al.*, 1990; Mennan and Isik, 2003). Karar *et al.* (2005) also stated that crop husbandry, the use of the same herbicide, and the entrance of new invasive weed species into the areas may cause the diversification and distribution of weed flora in a given habitat.

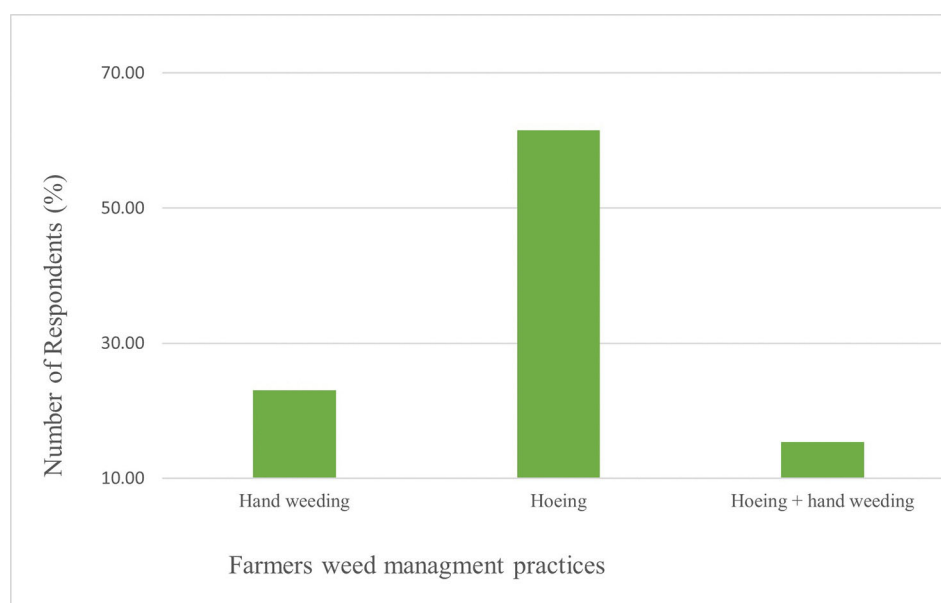
**Figure 2.** Farmers weed management practices in tomato fields.

Table 6. Farmers respondents on the use of fertilizers rate, tomato varieties and previous crop.

Fertilizers rate (%)			Varieties used (%)				Previous crop Sown (%)			
Above	Below	Optimum	Galilea	Koshoro	Local	Unknown	Maize	Onion	Tef	Others
7.69	23.08	69.23	53.80	23.30	12.10	10.30	48.70	25.60	10.30	15.4

Farmers perceptions and practices on weed management in tomato fields

In this study, 61% of the respondents used hoeing, followed by hand weeding (23%), and hoeing plus hand weeding (15%) for the management of weeds in the tomato fields (Figure 2). About 48% of tomato growers rotated maize after tomato, and 25% of them planted onion after tomato to reduce the weed seed bank in the soil by interrupting germination and suppressing weed growth.

On the other hand, amongst tomato growers, 48% used an improved tomato variety named “Galilea,” followed by Koshoro (17%), whereas the remaining used local and unknown varieties (Table 6). Furthermore, a significant proportion of growers (69%) used recommended fertilizer rates, whereas the others used above and below recommendation rates.

About 46% of respondents stated that *Tuta absoluta* was one of the biggest obstacles to tomato production in the surveyed locations, along with weeds. This could be as a result of the insect’s resistance to numerous insecticide classes and a lack of knowledge about integrated pest management.

Conclusions

A total of 63 weed species under 23 families were identified, and the composition, distribution, and diversity of the weed flora were determined. *Portulaca oleracea* and *Cyperus rotundus* were the most abundant and dominant weed species. About 61% of respondents in the surveyed areas adopted hoeing for the management of weeds in tomato fields. The weed community index was also different among the studied areas. Therefore, various eco-friendly weed management strategies, such as good crop husbandry, biological control, and integrated management, should be designed to increase tomato yield in Ethiopia.

Data availability

Underlying data

DANS-EASY: DATA OF WEED ASSESSMENT IN TOMATO FIELDS, <https://doi.org/10.17026/dans-z9v-c53d> (Dereje, 2023a).

This project contains the following underlying data:

- Arsi.xlsx (weed species composition in tomato farm in West Arsi Zone)
- East Wollega.ods (weed species composition in tomato farm in East Wollega Zone)
- East shewa.ods (weed species composition in tomato farm East Shewa Zone)
- West shewa.xlsx (weed species composition in tomato farm in West Shewa)
- Sidama.xlsx (weed species composition in tomato farm in Sidama Zone)

FARMERS PERCEPTIONS ON THE WEED MANAGEMENT IN TOMATO FIELDS, <https://doi.org/10.17026/dans-xwe-ufj6> (Dereje G., 2023b).

This project contains the following underlying data:

- farmers perception.xlsx (farmers perception and practices on weed management in tomato fields)

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

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General Comments:

The study titled "**Assessment of weed species composition and diversity in tomato (*Solanum lycopersicum* L.) farms in Ethiopia**" presents crucial insights into prevalent weed species in major Ethiopian tomato-growing regions. While the methodology involving quadrats and field surveys appears suitable, enhancing the study's credibility would benefit from a more comprehensive exposition of sampling procedures and statistical analyses.

The study's wide-ranging coverage across multiple tomato-growing zones and identification of 63 weed species across diverse regions constitute a noteworthy contribution. However, a more profound investigation into the ecological impact and potential management strategies targeting dominant species like *Portulaca oleracea* and *Cyperus rotundus* would augment the study's depth. Furthermore, there are significant areas in need of additional elucidation and clarification.

Specific Comments:

Weed Species Diversity: Although the identification of dominant weed species is insightful for forecasting population dynamics, the article could amplify its depth by discussing the ecological impact or potential management strategies specifically aimed at these dominant species.

Weed Management Practices: Commendably, the study incorporates farmers' perceptions and practices regarding weed management. However, reinforcing the analysis of these practices' effectiveness in controlling identified weed species would substantiate the study's findings.

Weed Similarity Index: While the discussion on weed community index variation among different regions is informative, a more comprehensive exploration of contributing factors such as climate, soil types, or agricultural practices would enrich the analysis.

Figure 1 Revision: Improving the visualization of the studied areas is recommended. Presenting an isolated map of Ethiopia within a frame, accompanied by an inset box highlighting the different study areas in distinct colors, would provide a clearer representation.

Quadrats in Field Studies: The absence of information regarding the number of quadrats utilized within each field studied diminishes the methodology section's clarity. Including this detail would

strengthen the methodology by offering insight into sampling intensity.

Materials and Methods Rewrite: Enhancing the methodology section with subheadings and recent citations would enhance clarity and comprehensibility regarding the study's procedures.

Missing Information on Farmer Surveys: Despite referencing surveys conducted near farmers, essential details about survey methodology, sampling techniques, respondent numbers, and survey questions are missing. The inclusion of this information is crucial for understanding farmers' perspectives on weed management practices.

Herbicide Use Data: While Table 6 presents fertilizer rates, the absence of herbicide use information is notable. Considering the study's focus on weed species, including data on herbicide frequency and types used would align with the primary objectives.

Inadequate Results Presentation: The article lacks the presentation of crucial data obtained during interviews with farmers, including information on cropping systems, crop varieties, management practices, and herbicide history.

Advanced Statistical Tests: While the article outlines frequency, abundance, dominance, and similarity index calculations, further detailed explanations or statistical validations of these indices would bolster methodological rigor. Integrating more advanced statistical analyses like ANOVA, multivariate tests, or Multiple Correspondence Analysis (MCA) would provide comprehensive insights into weed species variation across different zones.

Discussion and Conclusion: The discussion section requires enhancement, particularly in relating the obtained results and the study's impact. Moreover, the conclusion could benefit from specific, actionable recommendations for improving weed management strategies based on identified weed species and prevalent practices.

In summary, the study significantly contributes to understanding weed species in Ethiopian tomato fields. Strengthening the methodology and discussion by providing a deeper analysis of dominant species, assessing the effectiveness of current weed management practices, and offering specific recommendations would elevate the article's impact in addressing challenges related to weed management in tomato production.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Agroecological Weed Management

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

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