

Survey and Identification of Major Weeds of Seeds Spice in Ethiopia

Merga Jibat^{1*}, Wakjira Getachew¹, Abukiya Getu¹ and Habetewold Kifelew²

¹Tepi National Spices Research Centre, Ethiopian Institute of Agricultural Research, Teppi, Ethiopia; ²Holota Agricultural Research Centre, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia

ABSTRACT

In Ethiopia coriander (*Coriandrum sativum* L.), fenugreek (*Trigonella foenum-graecum*) and black cumin (*Nigella sativa* L.) are economically important seeds spices in the family of *Apiaceae*, *Fabaceae* and *Apiaceae* (Umbelliferae), respectively. They are highly suffering due to weed infestation especially competing for water and nutrient. However, before estimating yield losses due to weeds and devising weed control strategies, identification and quantification of weeds are very important. The weed survey was conducted in East showa, Arsi, Bale, North wollo and North Gondar zones during 2016 and 2018 in main cropping seasons to identify most common and prevalent weeds associated with seeds spice (coriander, fenugreek and black cumin). Weed species characteristics, density, frequency, relative density, relative frequency, summed dominant ratio over locations and seasons were calculated. The result shows that a total of 22, 37 and 21 weed species were identified in coriander, fenugreek and black cumin fields, respectively. The most important families according to the number of represented species were *Amaranthaceae*, *Caryophyllaceae*, *Primulaceae* and *Fabaceae* in coriander, *Amaranthaceae*, *Fabaceae* and *Polygonaceae* in fenugreek and *Chlorideae* and *Scrophulariaceae* in black cumin fields. The frequency of individual weed species in coriander, fenugreek and black cumin field ranged from 0.14% up to 1%, 0.13% up to 1% and 0.25% up to 5% while the dominance value ranged from 0.14 up to 49.1%, 0.25 up to 26.5% and 0.25 up to 4.5%, respectively. The most frequent and dominant weed was *Chenopodium album* in coriander field whereas, the most frequent weed was *Chenopodium album* and the most dominant weed was *Drymaria cordata* in fenugreek field. In black cumin field *Cynadon dactylon* and *Solanum nigrum* are most dominant and the most frequent weeds respectively. This survey has ranked the most abundant and troublesome weed species in coriander, fenugreek and black cumin growing areas of Ethiopia. Therefore this information is vital for setting research and developmental work priorities concerning coriander, fenugreek and black cumin weeds of the study area

Keywords: Black cumin; Coriander; Fenugreek; Survey; Weeds

INTRODUCTION

Spices are well known for their flavoring, culinary uses and essential oil derivatives. They are also valued for their coloring, as preservatives and fumigants, in pharmaceutical, textile and other industry [1]. They do fetch high premium price for they are highly concentrated by nature and are considered as an alternative cash generating commodity to stabilize the fluctuating price of coffee in the international trade [2]. Production of essential oil in an agro industry venture that effectively fits the national development endeavors of most developing countries, including Ethiopia. Development of this spice does not only benefit producing farmers but also the other population involved in different tasks.

The annual global economic loss caused by weeds has been estimated at more than \$100 billion U.S. dollars [3]. Weeds are undesirable plants, which infest different crops and inflict negative effect on crop yield either competition for water or nutrients or space or light [4]. There are innumerable reports on the inhibitory effects of weeds on crop plants [5]. Weeds are notorious yield reducers that are, in many situations, economically more important than insects, fungi or other pest organisms. At low density, weeds do not affect yield and certain weeds can even stimulate the crop growth [6].

Weeds, considered as obnoxious plants, are one of the pests associated with any agriculture endeavor and compete with coriander, fenugreek and black cumin plants for sunlight, space, water, and nutrients in the soil. Weeds may also act as alternate

Correspondence to: Merga Jibat, Tepi National Spices Research Centre, Ethiopian Institute of Agricultural Research, P.O. Box 34, Teppi, Ethiopia, Telephone: (+251) 475-560356; E-mail: mergajibat@gmail.com

Received: December 11, 2018; **Accepted:** March 19, 2019; **Published:** March 27, 2019

Citation: Jibat M, Getachew W, Getu A, Kifelew H (2019). Survey and Identification of Major Weeds of Seeds Spice in Ethiopia. *Plant Pathol Microbiol*; 10:477. doi: 10.35248/2157-7471.10.477

Copyright: © 2019 Jibat M, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

hosts to insect pests and pathogens attacking seeds spice. Research indicated that, worldwide, over 10% of agricultural production is lost as a result of crop weed competition for the resources light, water and nutrients [7]. According to Akobundu [8] when weeds are left uncontrolled, yield losses range from 20-100%, depending upon the crop and its environment. The author reported loss estimates of 5% in developed countries, 10% in the less developed countries and 25% in the least developed countries.

Coriander, fenugreek and black cumin productions are the major activity in Tepi National Spices and other national and regional research centre. These three crops are grown almost anywhere in the in the mid altitude and high land areas of Ethiopia as source of income.

Surveys are commonly used to characterize weed populations in cropping systems [9]. Therefore, to develop an effective weed management program, a thorough survey is necessary to address the current weed problems in the field. In addition, survey information is entirely important in building target oriented research programs. So far, no related study has been conducted regarding the occurrence, distribution and identification of common weeds associated with coriander, fenugreek and black cumin in Ethiopia.

Therefore information generated in this research is important and very useful in predicting the invasive potential of weeds biotypes over time and may provide imminent for effective control strategies. Therefore this survey was conducted with the following objectives:

- To identify and classify common weeds associated with coriander, fenugreek and black cumin at a major production areas of Ethiopia and
- To document the kinds of weed species and its relative distribution.

METHODS

The weed survey was conducted in East Shewa, Arsi and Bale zone of Oromiya and North Gonder and South Wollo zone of the Amhara regional state. Those areas are major producing areas of seeds spices in Ethiopia. The surveys were conducted during 2016 and 2018 main cropping season using quadrat method. Since the area of seeds spice grown by a household is about 1 ha or less, a 0.5 m × 0.5 m quadrat samples were taken at 2-3 m interval in cross diagonal line by randomly placed in weed infested areas of each of the production fields. All weed species there in were uprooted, cleaned, and separately placed in plastic bags. There were five sampling sites per area taken. 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 [10] 'Flora of Andhra Pradesh' by Pullaiah and Chennaiah [11] Weed Identification and Control Guide [12].

Data analysis

After the quantitative weed measurements i.e., density, relative density, frequency, and relative frequency, summed dominant ratio (SDR) were calculated by the following formula. Initially MS Excel were used to compile the data.

- Density (D)=Total number of individuals of a species in all quadrates/Total number of quadrates used

- Frequency (F)= (Number of quadrates in which a given species occurs/Total number of quadrates used)
- Relative density (RD)=(Density of a given species/Total density for all species) × 100
- Relative frequency (RF)=(Frequency of a given species/Total frequency for all species) × 100
- Summed Dominant Ratio (SDR)=(Relative density/Relative frequency) × 100

RESULTS AND DISCUSSION

Coriander

A total of 22 weed species were identified from coriander field. The most important families according to the number of represented species were *Amaranthaceae*, *Caryophyllaceae*, *Primulaceae*, *Fabaceae* and *Polygonaceae*. The frequency of occurrence of individual weed species ranged from 0.14% up to 1% while, the infestation level (dominance) ranged from 0.14% up to 49.1%. The most frequent and dominant weed were *Chenopodium album* (Table 1).

Fenugreek

From surveyed fenugreek field a total of 37 weed species were identified. The most important families according to the number of

Table 1: Weed composition, dominance, frequency, relative density, relative frequency, summed dominant ratio in coriander field of major growing areas of Ethiopia in main cropping seasons of 2016 and 2018.

S/N	Name Weeds	Family	Coriander'				
			D	F	RD	RF	SDR
1	<i>Avena fatua</i>	Poaceae	0.71	0.43	0.44	3.8	11.6
2	<i>Phalaris minor</i>	Poaceae	2.86	0.29	1.76	2.53	69.6
3	<i>Chenopodium album</i>	Amaranthaceae	49.1	1	30.3	8.86	342.1
4	<i>Vicia hirsutum</i>	Fabaceae	8.71	0.86	5.37	7.59	70.76
5	<i>Vicia sativa</i>	Fabaceae	10.4	1	6.43	8.86	72.59
6	<i>Anagalis arvensis</i>	Primulaceae	15.1	1	9.34	8.86	105.4
7	<i>Solanum nigrum</i>	Solanaceae	2.86	0.57	1.76	5.06	34.8
8	<i>Oxalis corniculata</i>	Oxalidaceae	8.14	0.86	5.02	7.59	66.12
9	<i>Medicago denticulate</i>	Fabaceae	0.71	0.43	0.44	3.8	11.6
10	<i>Fumaria parviflora</i>	Papaveraceae	5.57	0.71	3.44	6.33	54.29
11	<i>Cynodon dactylon</i>	Chlorideae	1.71	0.43	1.06	3.8	27.84
12	<i>Gnaphalium affine</i>	Asteraceae	0.57	0.29	0.35	2.53	13.92
13	<i>Polypogon fudax</i>	Poaceae	2.43	0.43	1.5	3.8	39.44
14	<i>Polygonum plebijum</i>	Polygonaceae	15.1	0.86	9.34	7.59	123
15	<i>Drymaria cordata</i>	Caryophyllaceae	26.1	0.57	16.1	5.06	318.4
16	<i>Euphorbia spp</i>	Euphorbiaceae	0.14	0.29	0.09	2.53	3.48
17	<i>Rumex crispus</i>	Polygonaceae	7	0.57	4.32	5.06	85.26
18	<i>Spergula arvensis</i>	Caryophyllaceae	2.29	0.14	1.41	1.27	111.4
19	<i>Melilotus indica</i>	Fabaceae	0.43	0.14	0.26	1.27	20.88
20	<i>Ammania baccifera</i>	Lythraceae	0.71	0.14	0.44	1.27	34.8
21	Other number	~	0.71	0.14	0.44	1.27	34.8
22	<i>Galinsoga spp</i>	Asteraceae	0.57	0.14	0.35	1.27	27.84

'D-Density, F-Frequency, RD-Relative Density, RF-Relative Frequency, SDR-Summed Dominant Ratio

represented species were *Amaranthaceae*, *Fabaceae* and *Polygonaceae*. The frequency of occurrence of individual weed species ranged from 0.13% up to 1% while, the infestation level (dominance) ranged from 0.25% up to 24.9%. The most frequent and dominant weed was *Chenopodium album* (Table 2).

Black cumin

From surveyed black cumin field a total of 21 weed species were identified. The most important families according to the number of represented species were *Chlorideae* and *Scrophulariaceae*. The

Table 2: Weed composition, dominance, frequency, relative density, relative frequency, summed dominant ratio in fenugreek field of major growing areas of Ethiopia in main cropping seasons of 2016 and 2018.

S/N	Name Weeds	Family	Fenugreek				
			D	F	RD	RF	SDR
1	<i>Phalaris minor</i>	Poaceae	0.63	0.13	0.35	0.88	39.34
2	<i>Chenopodium album</i>	Amaranthaceae	24.9	1	13.7	7.02	195.7
3	<i>Vicia hirsutum</i>	Fabaceae	3.88	0.75	2.14	5.26	40.65
4	<i>Vicia sativa</i>	Fabaceae	10.8	1	5.94	7.02	84.58
5	<i>Anagalis arvensis</i>	Primulaceae	8.38	0.63	4.62	4.39	105.4
6	<i>Solanum nigrum</i>	Solanaceae	15.1	0.38	8.35	2.63	317.3
7	<i>Oxalis corniculata</i>	Oxalidaceae	3.38	0.63	1.86	4.39	42.48
8	<i>Medicago denticulate</i>	Fabaceae	1	0.75	0.55	5.26	10.49
9	<i>Cynadon dactylon</i>	Chlorideae	8.63	0.88	4.76	6.14	77.55
10	<i>Gnaphalium affine</i>	Asteraceae	6	0.63	3.31	4.39	75.53
11	<i>Polypogon fudax</i>	Poaceae	8.13	0.63	4.49	4.39	102.3
12	<i>Polygonum plebijum</i>	Polygonaceae	19.1	0.63	10.6	4.39	240.7
13	<i>Galinsoga ciliate</i>	Asteraceae	2.38	0.38	1.31	2.63	49.83
14	<i>Drymaria cordata</i>	Caryophyllaceae	26.5	0.63	14.6	4.39	333.6
15	<i>Stelaria media</i>	Caryophyllaceae	5.88	0.5	3.24	3.51	92.44
16	<i>Euphorbia spp</i>	Euphorbiaceae	0.63	0.25	0.35	1.75	19.67
17	<i>cyperus esculentus</i>	Cyperaceae	2	0.38	1.1	2.63	41.96
18	<i>Rumex crispus</i>	Polygonaceae	3.75	0.38	2.07	2.63	78.67
19	<i>Convolvulus arvensis L</i>	Convolvulaceae	0.63	0.13	0.35	0.88	39.34
22	<i>Echinochloa colona</i>	Poaceae	0.5	0.13	0.28	0.88	31.47
23	<i>Caesulia axillaris</i>	Asteraceae	0.13	0.13	0.07	0.88	7.867
24	<i>Lathyrus aphaca</i>	Fabaceae	0.25	0.25	0.14	1.75	7.867
25	<i>Amaranthus viridis</i>	Amaranthaceae	0.63	0.25	0.35	1.75	19.67
26	<i>Ageratum Spp</i>	Asteraceae	0.5	0.13	0.28	0.88	31.47
27	<i>Malva parviflora</i>	Malvaceae	1.25	0.13	0.69	0.88	78.67
28	<i>Ludwigia hissoipifolia</i>	Onagraceae	1.38	0.38	0.76	2.63	28.85
29	<i>Spergula arvensis</i>	Caryophyllaceae	5.75	0.5	3.17	3.51	90.48
30	<i>Ammania baccifera</i>	Lythraceae	0.5	0.13	0.28	0.88	31.47
31	<i>Polygonum hydropiper</i>	Polygonaceae	1.38	0.13	0.76	0.88	86.54
32	<i>Dopatrium junceum</i>	Scrophulariaceae	1.88	0.13	1.04	0.88	118
33	<i>Coronopus didymus</i>	Brassicaceae	0.25	0.13	0.14	0.88	15.73
34	<i>Other number</i>	-	9.88	0.63	5.45	4.39	124.3
35	<i>Stellaria aquatiica</i>	Caryophyllaceae	0.5	0.13	0.28	0.88	31.47
36	<i>Galinsoga spp</i>	Asteraceae	4.38	0.38	2.42	2.63	91.79
37	<i>Dactyloctenium aegypticum</i>	Poaceae	0.38	0.13	0.21	0.88	23.6

*D-Density, F-Frequency, RD-Relative Density, RF-Relative Frequency, SDR-Summed Dominant Ratio

frequency of occurrence of individual weed species ranged from 0.25% up to 5% while, the infestation level (dominance) ranged from 0.25% up to 4.5%. The most frequent weed was *Solanum nigrum* were as the most dominant weed was *Cynadon dactylon* (Table 3).

Dominant weeds were those species which occurred in relatively greater number than the other species. Most of the weeds found associated with the coriander, fenugreek and black cumin production areas are 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 considered 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 Wicks et al. [13]. He elaborated his claim by disclosing that where the average density of the species was <9 weeds/m² but, some species were found greater density within the specific field. Similar results were reported by Uddin et al. [9] who found that the density of the most species increased compared to densities obtained from all of the fields. These results are also in accordance with the findings of Javaid et al. [14] where they observed that the highest density and coverage was shown by the most common grass *Cynadon dactylon*.

Most of common weeds identified in this survey were found in annual nature. This can be explained by the fact that seeds of annual weeds survive in unfavorable conditions and they have able to complete their life cycle from seed to seed in one season

Table 3: Weed composition, dominance, frequency, relative density, relative frequency, summed dominant ratio in black cumin field of major growing areas of Ethiopia in main cropping seasons of 2016 and 2018.

S/N	Name Weeds	Family	Black cumin*				
			D	F	RD	RF	SDR
1	<i>Phalaris minor</i>	Poaceae	0.25	0.25	0.7	1.92	36.62
2	<i>Chenopodium album</i>	Amaranthaceae	2	0.75	5.63	5.77	97.65
3	<i>Vicia sativa</i>	Fabaceae	1.25	0.25	3.52	1.92	183.1
4	<i>Anagalis arvensis</i>	Primulaceae	0.25	0.25	0.7	1.92	36.62
5	<i>Solanum nigrum</i>	Solanaceae	0.75	5	2.11	38.5	5.493
6	<i>Oxalis corniculata</i>	Oxalidaceae	0.75	0.25	2.11	1.92	109.9
7	<i>Medicago denticulate</i>	Fabaceae	2	0.75	5.63	5.77	97.65
8	<i>Cynadon dactylon</i>	Chlorideae	4.5	0.75	12.7	5.77	219.7
9	<i>Gnaphalium affine</i>	Asteraceae	1	0.5	2.82	3.85	73.24
10	<i>Polypogon fudax</i>	Poaceae	2.25	0.5	6.34	3.85	164.8
11	<i>Polygonum plebijum</i>	Polygonaceae	2.5	0.5	7.04	3.85	183.1
12	<i>Galinsoga ciliate</i>	Asteraceae	1.5	0.25	4.23	1.92	219.7
13	<i>Stelaria media</i>	Caryophyllaceae	3.5	0.25	9.86	1.92	512.7
14	<i>Commelina benghalensis</i>	Commelinaceae	1.25	0.25	3.52	1.92	183.1
15	<i>Ageratum Spp</i>	Asteraceae	1.25	0.75	3.52	5.77	61.03
16	<i>Ludwigia hissoipifolia</i>	Onagraceae	1.5	0.25	4.23	1.92	219.7
18	<i>Ammania baccifera</i>	Lythraceae	1	0.25	2.82	1.92	146.5
19	<i>Dopatrium junceum</i>	Scrophulariaceae	3.75	0.25	10.6	1.92	549.3
20	<i>Other number</i>	-	2	0.25	5.63	1.92	293
21	<i>Stellaria aquatiica</i>	Caryophyllaceae	1	0.25	2.82	1.92	146.5

*D-Density, F-Frequency, RD-Relative Density, RF-Relative Frequency, SDR-Summed Dominant Ratio

[15]. Moreover, the weeds which appeared common in seeds spice production areas with the highest mean field densities indicate that these weeds were the more difficult to control. So, these species should be carefully monitored.

Since weed succession and distribution patterns in seeds spice fields are dynamic in nature, the composition of the weed flora may differ depending on location [9,16]. The weed vegetation of a particular area is determined not only by the environment but, also edaphic and biological factors that include soil structure, pH, nutrients and moisture status, associated crops, weed control measures and field history especially in local geographical variation [17].

SUMMARY AND CONCLUSION

Survey and identification of weeds were done in the coriander, fenugreek and black cumin production areas of Ethiopia during 2016 and 2018 main cropping season. The results of the survey provide a quantitative comparison of the common weed species in seeds spice production of major growing areas of Ethiopia. The frequency of individual weed species in coriander, fenugreek and black cumin field ranged from 0.14% up to 1%, 0.13% up to 1% and 0.25% up to 5% while the dominance value ranged from 0.14 up to 49.1%, 0.25 up to 26.5% and 0.25 up to 4.5%, respectively. The most frequent and dominant weed was *Chenopodium album* in coriander field whereas, the most frequent weed was *Chenopodium album* and the most dominant weed was *Drymaria cordata* in fenugreek field and in black cumin field *Cynadon dactylon* and *Solanum nigrum* are most dominant and the most frequent weeds respectively. This survey has ranked the most abundant and troublesome weed species in coriander, fenugreek and black cumin growing areas of Ethiopia. Therefore this information is vital for setting research and developmental work priorities concerning coriander, fenugreek and black cumin weeds management. In the future, more survey work is needed on a regular basis to identify possible problematic weed and weed population shifts and direct research toward new or improved control measures.

ACKNOWLEDGEMENTS

Author thanks Tepi National Spices Research Center and Spices Program Research project for providing all the necessary facilities and support. My sincere thanks to Debrezeit, Kulumsa and Sinana agricultural research centre spice research team for their help during survey and data collection.

REFERENCES

1. Purselglove JW, Green EG, Robbins SRJ. Spices. AGRIS. 1991;2:1.
2. Girma H, Digafie T, Edossa E. Spices research achievements, revised edition, Ethiopia. Insti Agricul Res. 2008;12:23.
3. Appleby AP, Muller F, Carpy S. Weed control. Ullmann's Encyclo Industr Chemi. 2000;687-707.
4. Reddy TY, Reddi GHS. Principles of agronomy. Kalyani Publishers, Noida, India. 2011;527.
5. Javaid AR, Bajwa R, Rabbani N, Anjum T. Comparative tolerance of rice (*Oryza sativa* L.) genotypes to purple nutsedge (*Cyperus rotundus* L.) allelopathy. Allelopa J. 2007;20:157-166.
6. Thijssen R. Agroforestry and soil organic matter, about green manure, mulch, decomposition and nutrient release. ICRAF, Nairobi. In: S. Manandhar, B.B. Shrestha and H. D. Lekhak. 2007. Weeds of paddy field at Kirtipur, Kathmandu. Sci World. 1991;5.
7. Parker C, Fryer JD. Weed control problems causing major reductions in world food supplies. 1975.
8. Akobundu IO. Sugarcane. Weed Science in the Tropics: Principles and Practices. Akobundu IO (ed.). John Wiley and Sons, New York, USA. 1987;414-416.
9. Uddin MK, Juraimi AS, Ismail MR, Brosnan JT. Characterizing weed populations in different turfgrass sites throughout the Klang Valley of Western Peninsular Malaysia. Weed Technol. 2010;24:173-181.
10. Hooker JD. The flora of British India. AJPS. 1897;3:2.
11. Pullaiah T, Chennaiah E. Flora of Andhra Pradesh (India), Scientific Publication. 1997;2:910-911.
12. Donaldson S, Bowers G. Weed identification and control guide, Educational Bulletin-98-01, University of Nevada Cooperative Extension. 1998.
13. Wicks GA, Popken DH, Mahnken GW, Hanson GE, Lyon DJ. Survey of winter wheat (*Triticum aestivum*) stubble fields sprayed with herbicides in 1998: Weed control. Weed Technol. 2003;17:475-484.
14. Javaid A, Shafique S, Shafique S. Invasion of noxious alien weed *Parthenium hysterophorus* L. in grazing lands of Lahore, Pakistan. J Ani Plant Sci. 2009;19:149-153.
15. Singh A, Sharma GP, Raghubanshi AS. Dynamics of the functional groups in the weed flora of dryland and irrigated agro-ecosystems in the gangetic plains of India. Weed Bio Manage. 2008;8:250-259.
16. Moody K, Munroe CE, Lubigan RT. Major weeds of the Philippines. Second Edition. UPLB, Laguna, Philippines. 2014.
17. Hakim MA, Juraimi AS, Ismail MR, Hanafi MM, Selamat A. Distribution of weed population in the costal rice growing area of kedah in peninsular Malaysia. J Agron. 2010;9:9-16.