P-ISSN: 2305-6622; E-ISSN: 2306-3599
International Journal of Agriculture and Biosciences
www.ijagbio.com; editor@ijagbio.com

Research Article

Distribution and Importance of *Cuscuta campestris* on Lentil Growing Areas: A Preliminary Survey from Ethiopia

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Article History: 1269 Received: 2-Dec-20 Revised: 18-Jan-21 Accepted: 10-Feb-21

ABSTRACT

Cuscuta campestris is holo- parasitic weed and already well-established in several parts of Ethiopia and mostly parasitizes noug, linseed, some vegetable crops and coffee trees. Recent preliminary observation also indicated that C. campestris parasitizes lentil crops in Southwest Shewa Zone and Sebata Hawas Special District of the Oromia Regional State of Ethiopia. Therefore, the field survey was conducted in major lentil growing areas during 2015 up to 2016 main cropping season to determine the distribution and importance of C. campestris in lentil growing areas and learn the farmers' perceptions about control strategies and their impact. The survey was done by stopping along main roads accessible for vehicle at 5 km interval. At each stop, 5m by5m sampling was used to determine the prevalence of C. campestris. Purposive sampling methods were used to interview 180 households selected from Elu and Sebata Hawas district. Quantitative and qualitative data were taken through interviews, pairwise ranking and observations made by transect walks across selected villages. As a result, the highest prevalence (90%) was recorded at Sebata Hawas district. The interviewed farmers response about 14-29% yield losses of lentil was reported due to C. campestris and distributed mainly by farm machineries flowed by over flooding of Awash river. Farmers also believed that hand weeding, crop rotation and deep ploughing were the most important control measure to reduce C. campestris.

Key words: Cuscuta Campestris, Distribution, Importance, Lentil.

INTRODUCTION

The genera *Cuscuta* (dodder) are obligate holo-parasitic plants with over 170 spp spread all over the world (Lanini and Kogan, 2005). *Cuscuta campestris* Yuncker, commonly called "witchs hair", is the most agriculturally damaging dodder species parasitizing above-ground parts of broad-leaved plants, including weeds, field crops, vegetables and ornamentals throughout the cultivated areas of the world (Goldwasser *et al.*,2012). Each *Cuscuta* species can parasitize many hosts, having a wide physiological tolerance of the metabolism and chemical composition of host species (Cooke and Black,1987); this is a characteristic of parasitic angiosperms (Kuijt, 1969). *Cuscuta* has an affinity for nitrophilous hosts such as legumes (Cooke and Black,1987) and succulents, but will parasites a diverse range of angiosperms mainly dicotyledons, although grasses and *Cyperaceae* may be minor hosts (Cooke and Black,1987) and onions are susceptible.

Several *Cuscuta* species are indigenous to Ethiopia including *C. Kilimanjari*, but these rarely attack any crops (Parker *et al*.,1992). Two exotic species have already been introduced to Ethiopia at some time in the past are now widely distributed and troublesome. These are *Cuscuta campestris* (*C. campestris*), especially serious on noug, and *C. epilinum*, restricted to linseed (Parker *et al*.,1992). Then after, *Cuscuta* spp are widespread in several parts of *Welega*, *lllbabor*, *Gojam*, *Gonder*, *Tigrai*, *Arsi* and *Kefa* regions in noug, linseed, and vegetable crops (Rezene and Gerba, 2006 and Rezene and Kedir, 2008). In most areas, it was observed that the twining vines of this parasite not only mitigate the nutrient of the host plants but also prevent growth and fruit formation. Large areas of noug and linseed have had to be abandoned every year in the above-mentioned areas mainly because of heavy *Cuscuta* infestation. The grain yield losses because of *Cuscuta* infestation in noug and linseed fields were also increased time to time and spread to further new areas with a few years (Nigussie and Yeshanew, 1992).

The available research work suggests that invasive weeds in Ethiopia has been going on occasionally for over a decade. Due to various constraints, from the whole range of parasitic weeds, meaningful research work was undertaken

Cite This Article as: Gebrekidan Feleke, Shugute Addisu, 2021. Distribution and Importance of Cuscuta campestris on Lentil Growing Areas: A Preliminary Survey from Ethiopia. Int J Agri Biosci, 10(1): 60-64. www.ijagbio.com

the importance and distribution of weeds through questionnaires and experimentation. To the best of our knowledge, in Ethiopia, there are no previous reports on the infestation of dodder in lentil fields. Currently, preliminary field observations in 2014/15 cropping season were made at Southwest Shewa Zone and Sebata Hawas Special district of the Oromia Regional State. As such it was rated as a number one serious problem and new parasitic weed on farmers' lentil fields in which most farmers reported and seeing it for the last few years. However, there were no comprehensive information is available concerning its infestation intensity and the importance of *Cuscuta* spp. especially on lentil production areas. To be able to give suitable recommendations for *Cuscuta* control the prerequisites are providing quantitative baseline data on its distribution and get farmers perception about their knowledge and attitudes towards different control measures. Therefore, the objective of this survey was to assess the pest status of *Cuscuta* spp by determining its incidence and severity in lentil production areas and to learn about the farmers' perceptions about control strategies and difficulties concerning the *C. campestris* weed.

MATERIALS AND METHODS

Description of the Study Areas

Sebata Hawas, Elu and Becho districts are some parts of Oromia Regional State of Ethiopia (Figure 1). Becho and Elu district also included in Southwest Shewa zone of Oromia Regional State. Sebata Hawas district also included in Oromia Special Zone around Finfinne, which separate by Awash river from southwest Shewa Zone. Based on the district agricultural and rural development office 87.2% of the land is used for agriculture,4.2% is pasture,2.9%is forest,1.86%is devoted for industrial construction,1.68% is covered by lakes and other bodies of water and built-up land covers1.28% with an elevation range from 1700-3385 meter above sea level. Becho district also bordered by Kokir on the south, Walisona Goro on the west, Dawo on the northwest, Elu on the north and Tole on the east. Its geographical location is 8°40′ latitude 38°13′ longitude with an elevation of 2193-7195 meter above sea level. Elu district is located between the two districts, which is bordered by Becho on the south, Dawo on the west, waliso on the north and Awash river/Sebata Hawas on the east. and its geographical extent ranges from 8°44'59.99" N and 38°19'60.00".

The Survey Method

Field survey at the vegetative and flowering stage of lentil was undertaken during December 2015 through 2016 in major lentil growing areas of Southwest Shewa Zone and Sebata Hawas special districts of Oromia Regional State to determine the infestation level of *C. campestris* on lentil and to identify the hot spot areas. Survey trips were planned by establishing a route through each location based on lentil cultivation areas. In each route, sampling was selected randomly from fields at 5 km distance on either side of the main road within the radius of 0.5 km. At each stop, a 5m-by-5m sampling area was used to determine the infestation levels. A total of ninety-five fields were observed in Becho (10), Elu (37) and Sebata Hawas (48) districts. Prevalence in each lentil fields were also recorded. The *Cuscuta* infestation level in lentil fields was estimated using a rating scale from 0 to 6 according to Schmitt (1981) as indicated in Table 1.

Table 1: A Rating scale for *C. campestris* weed species

Rating scale	Infestation	Definition
0	Not infested	No *Cuscuta* emerged
1	Very low	10% of *Cuscuta* cover the sample field
2	Low	15-20% of *Cuscuta* cover the sample field
3	Moderate	40% of C*uscuta* cover the sample field
4	High	50 75% of *Cuscuta* cover he sample field
5	Very high	90-95% of *Cuscuta* cover of the sample field
6	Completely destroyed	Host plants dead, no yield

Before conducting the actual field assessment, a single visit informal survey was conducted to decide the survey areas and communicate the Southwest Zone of Oromia and Sebata special district experts to decide the most infected areas. Purposive sampling methods were used to select three districts based on the infestation level of *Cuscuta* campestris. A total of nine kebeles were selected from Elu and Sebata Hawas district based on infestation level of *C. campestris*. In general, 180 households were selected for interviews randomly, 20 farmers per each kebele. The questionnaires were comprised open and closed questions on the topics of basic data on lentil production system, the impact of *Cuscuta* from the farmers' point of view, the farmers' knowledge about control strategies against *Cuscuta* and the farmers' attitudes towards certain control measures. The farmers who partook in the discussions were made with selected key informants from different age class, gender groups as well as elected council members in each district. Gender representation was not easy in some of the kebeles, but an attempt was made to accommodate women in the discussion.

Data Analysis

Quantitative and qualitative data collected through the questionnaires were coded and the data entered into a computer for analysis using statistical package for SPSS. Descriptive statistics and cross-tabulation were used to summarized dataset.

RESULTS AND DISCUSSION

The prevalence (per cent of infested fields) of *C. campestris* is summarized in Table 2. The intensity of infestation of the parasite differed from one location to another. The maximum prevalence was recorded at Sebata Hawas (90%) followed by Elu (78%) district. This might be the farmers in this area, growing pulse crops as monocropping when the flooding of the Awash river leaving their farming lands without continues ploughing. Interestingly, there was a difference in the degree of intensity of infestation between fields within the same location due to heavy *C. campestris* infestation. It ranged between 4% -33 % at Sebata Hawas and 22% -27% at Elu district. These results are in agreement with those obtained by Yeshanew *et al.* (1993), who found that the uppermost prevalence of *Cuscuta* in noug field was recorded at Dera (90%) followed by Fogera (86%) and Bahr Dar (60%).

Table 2: Intensity of infestation of lentil fields by *C. campestris* in selected districts

Districts	No. of sampled Fields	Number of infested fields and percent of total crop area infested by *Cuscuta*												Total Prevalence
		Non infested		Very low		Low		Moderate		High		Very high		
		*	**	*	**	*	**	*	**	*	**	*	**	
Becho	10	6	60	4	40	--	--	--	--	--	--	--	--	40
Elu	37	8	21.7	--	--	10	27.0	9	24.3	10	27.0	--	--	78.3
S. Awas	48	5	10.4	--	--	16	33.4	15	31.2	10	20.8	2	4.2	89.6

*No. of infested fields ** Prevalence (%).

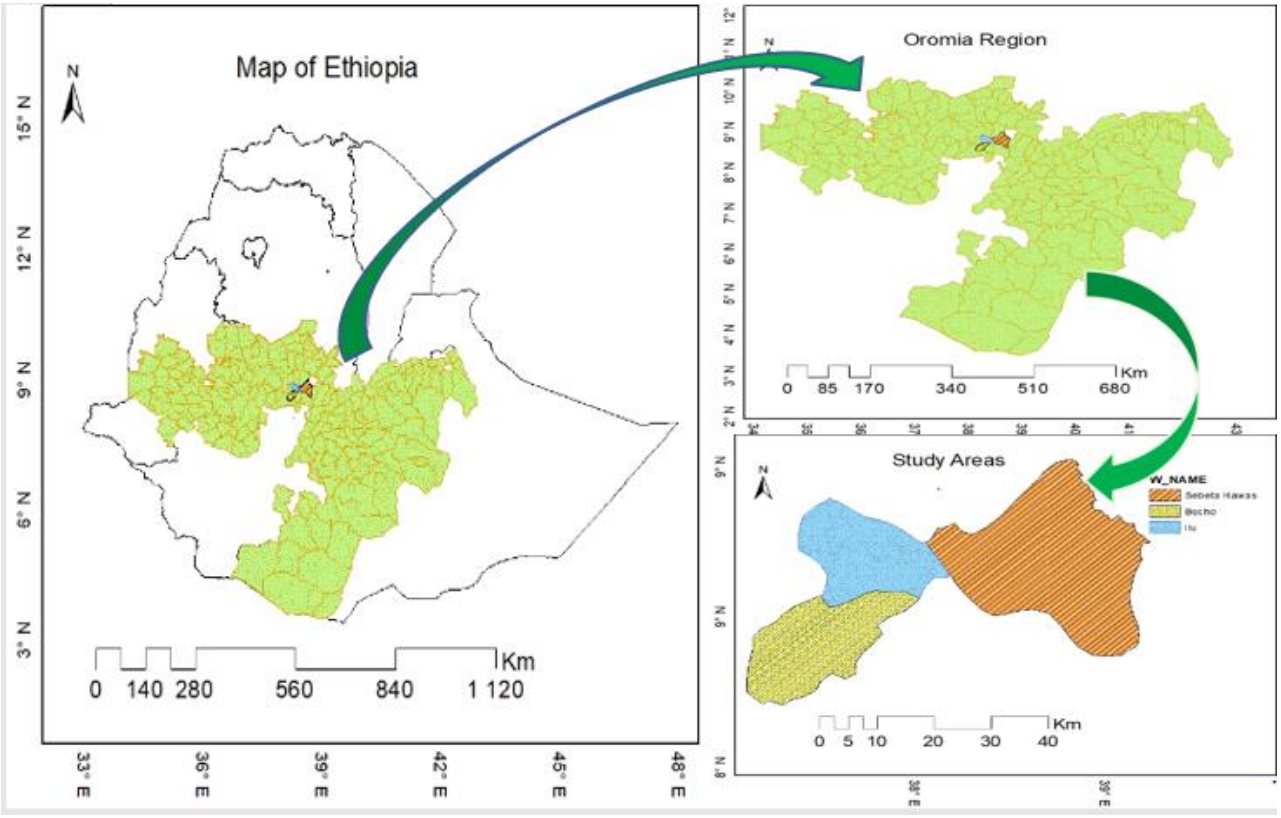

Fig. 1: Location map of the survey areas.

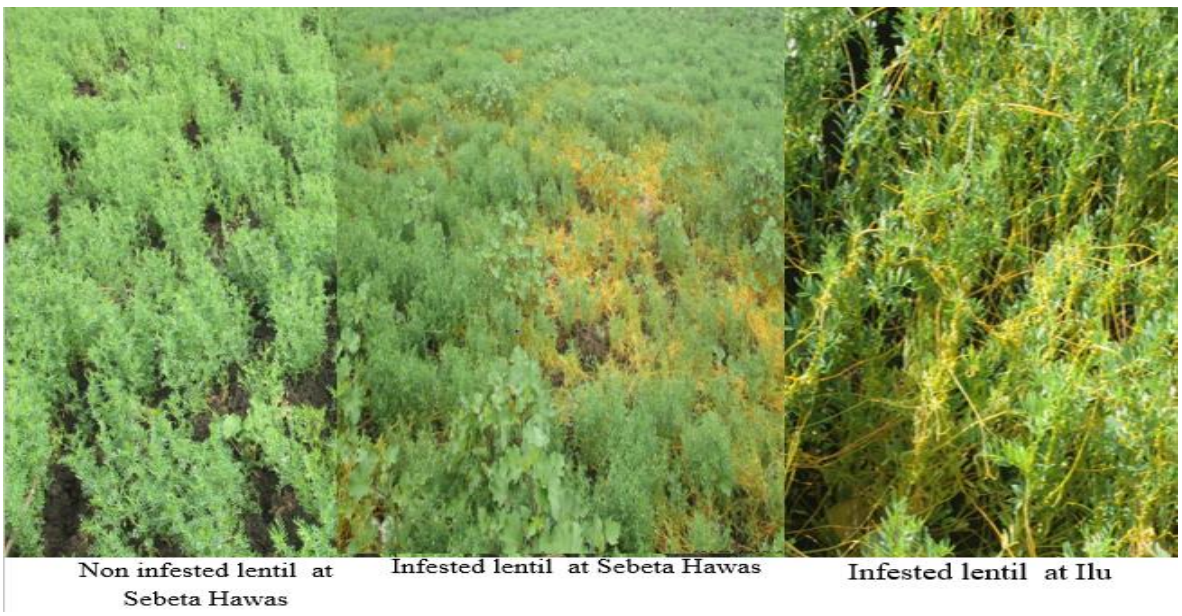

Fig. 2: Cuscuta campestris infested and non-infested field in both survey areas.

Beside the infestation of *C. campestris* survey in lentil field, many common herbaceous annual weedy species are hosts for *C. campestris* as shown the figure 2 below. The most notable ones include: *Xanthium spp.*, *Amaranthus spp.*, *Polygonum aviculare*, *Portulaca oleracea* and *Rumex spp.*

Socio-Economic Impact Assessment Based on Farmers' Perception

Almost all farmers in each Elu and Sebata Hawas district were aware of *C. campastirs*. However, time of awareness differed significantly. Nine and twelve per cent of the respondents in Elu and Sebata Hawas knew about *C. campastirs* between 1991 up to 2000 (Figure 3). In Sebata Hawas district the respondents became more aware of *C. campastirs* than Elu district before 1990. This may be attributed to the earlier introduction of the weed in Sebata Hawas as shown in figure 3 and most of lentil growing areas of the district covered by over flooding of Awash river, which helps the dissemination of dodder seed successfully. This is in agreement with the work of Baki *et al.* (2009), who reported that water can help to efficiently and successfully dispersed dodder seed in many abandoned sites.

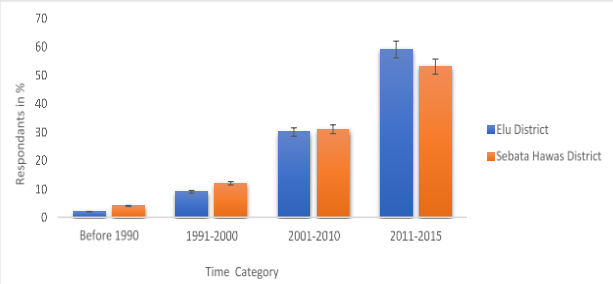

Figure 3: Time of farmers' awareness about C. campestris at Elu and Sebata Hawas districts

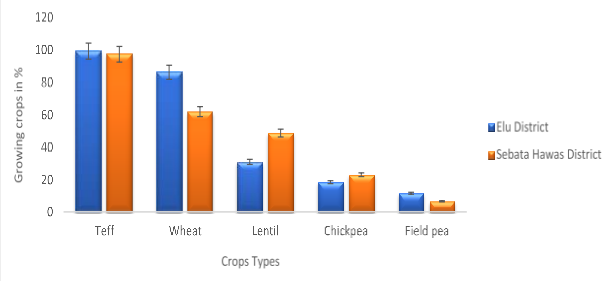

Figure 4: Percentage of major cultivating crops at Elu and Sebata Hawas districts.

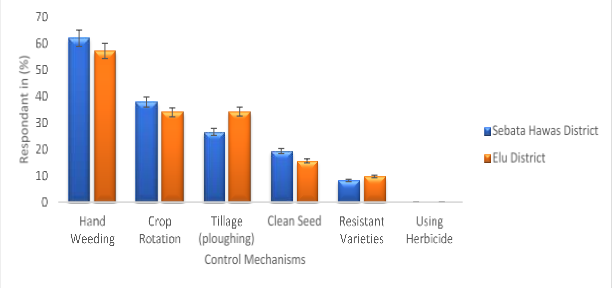

Figure 5: Farmers' perception about C. campestris control Mechanisms.

Table 3: Farmers perception on lentil yield redaction due to different production constraints in percentage at both districts.

No.	Production constraints	Estimated yield loss (%)
1	Diseases	13-35
2	Weed (C. *campestris*)	14-29
3	Low quality of seeds	15-25
4	Insect pests	15-20

Table 4: Farmers perception on means of C. campestris dispersal mechanism at both districts

No.	Dispersal mechanism	Percentage
1	Human	5.8
2	Animal	6.7
3	Flooding	49.2
4	Seed	18.1
5	Farm machinery	53.5
6	Wind	----
7	Birds	----

Amongst pulse crops, lentil occupying about 49 and 31% of the cultivated areas at Sebata Hawas and Elu next to teff and wheat, respectively (Figure 4). However, most of the interviewed farmers in the study area reported that the raised of *C. campestris* infestation, shortage of inputs like quality seed and fertilizer, diseases, insects and erratic rainfall were the most lentil production problems in their fields. Among these, farmers believed that *C. campestris* infestation, diseases and insect were contributed 14-29,13-35 and 15-20% for lentil yield reduction respectively (Table 4). In an earlier report by Moorthy *et al.* (2003), the field dodder species causing significant yield loss and quality in lentil, chickpea, linseed, green gram and black gram especially in rice-fallows. More specifically, Mishra (2009) states that yield reductions due to *Cuscuta* are 60-65% in chillies, 31-34% in green gram/black gram, 60-65% in Niger, 87% in lentil, 86% in chickpea, 72% in tomato and 60- 70% in alfalfa depending upon its intensity of infestation.

The dispersion strategy of dodder can be assisted by biological and non-biological means usually mediated by human activities. If Campestris remains in the crop field until it produces flowers and seeds without being removed, weed seeds are attached to the panicle of the plant, especially when it is piled in the ground after harvesting. Almost half the interviewed farmers reported that farm machineries (54%) were the most vital factor for the fast dispersal of *C. campestris* followed by over flooding of Awash river (49%), seed (18%) and animal (7%), respectively (Table 4). Different experimental and field studies suggest that water flows are major but largely over flooding for a broad range of Waterland and terrestrial plants, including many species with non-adapted seeds like Cuscuta (Brochet *et al.*, 2009; Soons *et al.*, 2016). Even if the farmer's perception biased to farm machineries, water can help to efficiently and successfully dispersed dodder seeds in many survey areas as visual observation. In contrast to this, Dodder seeds are heavy, and is not adapted for dispersal by water or wind, nor are they especially attractive to animals that could carry them from one farm to another (Rezene,1992). Farmers also didn't know that *C. campestris* seeds can be distributed or disseminated through wind and birds can carry seeds from one place to another. Even though, farmers are familiar with some of the causes that are responsible for the dissemination or distribution of *C. campestris*, the management they take to combat the weed are very few.

The most effective and economical methods to reduce dodder infestation is avoidance and prevention (Parker and Riches, 1993). Dodder is the only major weed problems that can be effectively controlled by crop rotation. However, the large weed and crop host range makes it difficult to avoid this pest by crop rotation and thus, careful

crop selection is essential (Parker, 1991). Since *Cuscuta* does not parasitize cereal/grasses, it can be controlled by this method. Thus, growing cereals or other grass crops continuously for more than a few years, may enable the downfall the dodder seed bank in the soil (Dawson, 1987). Additionally, dodder can be removed or controlled by hand weeding; however, it is not economical on extensive infestations. Interestingly, the interviewed farmers believed that the most common practice of controlling of *C. campestris* was hand weeding (62/57%) followed by crop rotation (38/34%) and continues ploughing (27/34%) at Sabata Hawas and Elu districts, respectively (Figure 5). As Lanini (2004) puts that, growing of wheat followed by corn in a field heavily infested with *C. campestris* reduced the number of dodder plants infesting tomato by 90%. Thus, two years of growing a non-host crop was effective in reducing the population. Unless the availability of clean seed and resistant varieties during planting time, about 19/16% and 8/10% of the interviewed farmers perceived that using clean seed and resistant varieties were moderately reducing *C. campestris* weed infestation at Sebata Hawas and Elu district, respectively. Most of the farmers didn't agree that herbicide application can significantly reduce *C. campestris* weed infestation in lentil field at both districts (Figure 5).

Conclusions

Cuscuta campestris is a stem parasitic plant poses a serious problem in oilseeds, pulses and vegetable crops in different areas of the country. The current field observations/survey in Becho, Elu and Sebata Hawas district revealed that serious trouble is caused by *C. campestris* in lentil production areas. The survey results also showed that the severity of infestation varies from one district to another district, even vary within the same location. Almost most of the respondent farmers are aware of *C. campestris*, its distribution and means of dissemination, and its negative impact on wellbeing and crop production. Farmers are also making some efforts to decrease the crop infestations by dodders such as hand cultivation, frequent ploughing and crop rotation with cereals. However, integrated management strategies involving preventive, cultural and herbicidal methods can provide an acceptable degree of *Cuscuta* control in field crops.

Acknowledgements

I gratefully acknowledge who helped me in all aspects to complete this research work. I would like to thank the Ethiopia Institute of Agricultural Research, Debre Zeit Agricultural Research Center, EIAR.

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