

Survey of *Orobanche* in vegetable crops in Khartoum State

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Abstract

Field surveys were undertaken during seasons 2004/05 – 2006/07 in Khartoum state along River Nile, White Nile and Blue Nile banks to assess the incidence of *Orobanche ramosa* and crop yield losses. Structured questionnaire was prepared and distributed to farmers on practices pertaining to the parasite.

The results of the surveys indicated that in all locations the species of broomrape was *Orobanche ramosa*. The major hosts were tomato, potato, eggplant, carrot and pepper with tomato and potato being the most infested. Along the River Nile banks, the production system is characterized by mono-cropping of potato and tomato which lead to severe infestation and yield losses may reach 100%. Proper control measures are practiced. However, some farmers hand pulls *Orobanche* after flowering, but they leave plants in the fields. Along the White Nile banks, farmers raise crops under residual soil moisture. Eggplant and tomatoes are the major crops and eggplant represents 70% of the cropped area. Infestation by *Orobanche* and yield losses is lower than in other areas. Farmers practiced hand-pull *Orobanche* and addition of fertilizers for control.

Survey along the Blue Nile banks revealed that farmers usually grow different crops but do not follow proper crop sequence. Major crops are tomato, onion, cucumber, alfalfa, carrot, eggplant and okra. The major hosts of *Orobanche* were tomato, carrot, eggplant and pepper. Infestation ranged between 60 – 100% and losses in yield ranged from 40 – 80%.

The agricultural schemes i.e. Ellsellate, Alban Kuku, Soba- West, Om-Arda, Waha, Elshaab and Gomea are characterized by fodder production, mainly Abu-sabeen and alfalfa. Production of vegetables includes okra at Gomea Scheme. Since these crops are non-hosts for *Orobanche*, no infestation was detected.

Introduction

Noxious parasitic weeds are a major constraint to agricultural production. Over 3500 species of parasitic flowering plants occur in the plant kingdom. Few species, however, are economically important. Parasitic weeds are grouped into three major families: Cuscutaceae, Orobanchaceae and Loranthaceae.

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Species belonging to the genus *Orobancha* are the most noxious parasitic weeds. *Orobancha* spp is an obligate root parasite on Solanaceous, leguminous and several other arable dicotyledonous vegetable and ornamental crops in addition to several weed species (Andrews, 1950, Abu Shakra *et al.* 1970). After the 1960s, vegetable production in Sudan was intensified for local consumption and export and was restricted to the Nile banks in the Northern, River Nile, Khartoum and Gezira States. Solanaceous crops such as tomatoes, eggplants, and potatoes were monocropped and as a result *Orobancha* started to spread south wards and infestation reached devastating levels in heavily infested soils. (Babiker, 1993).

In Sudan, control methods are restricted to hand pulling at flowering and seed setting, after damage has occurred and abandonment of susceptible crops (Braun *et al.* 1984, Babiker *et al.* 1993). Most farmers' plant locally produced seeds which are often contaminated with the parasite seeds, spread unfermented contaminated manure graze animals in infested fields, use infested hay to feed non – grazing animals are unaware of the reproduction means of the parasite and accordingly lack the proper phytosanitary measures. Hand-pulled plants are randomly thrown around the field and infested borders remain unchecked. Officials are unaware of the magnitude of the problem.

A survey was, there for, undertaken in Khartoum State to determine host range of *O. ramosa* L., infestation in different crops and yield losses cropping system, mapping of parasite in the State, areas of high risk and those free of *Orobancha* and control methods adopted by farmers in infested areas.

Materials and Methods

Field surveys were carried out during March in season 2004/05 - 2006/07 along the banks of the Blue Nile, White Nile and River Nile in the major production areas of Khartoum State (Fig. 1). Locations (36) were chosen and 6 fields in each location were randomly selected (Table 1- 4).

A total of 3 quadrates (1.0 m²) were sampled randomly in each field and the number of infested host plants recording. A percent infested host plant, relative to the total plants, was calculated. Yield losses were determined according to farmers' estimation. Structured questionnaire was prepared and included cropping system, production practices, knowledge of farmers on the parasite, control measures adopted and farmers perception of *Orobancha* problem.



Fig. 1. Location of surveyed areas and occurrence of *Orobanche* in Khartoum state.

Results

The results revealed that *O. ramosa* was the only species found in all locations. The major hosts of the parasite were tomato, potato, eggplant, carrot and pepper with tomato and potato being the most infested. Infestation of host crop was exhibited to various degrees in all locations except Wad Ramly Society (Table 1).

Eastern bank of River Nile

Mean infestation of *Orobanche* ranged between 0.0% in Wad Ramly Society and 100% in Elsagay and Abu Halima. Mean tomato yield loss amounted to 0.0% in Wad Ramly Society and 76.7% in Halfaya. At Elkadaro and Shambat mean infestation was 80 - 86% and yield losses ranged between 40 - 70%. At Khogalab, Elsaggay, Wawoosi, Elgeli and Wad- Ramly infestation was 60-

100% and yield losses were 40-80%. However, at Fakki Hashim infestation was low (10%) and yield loss was 30%. Interviewed farmers indicated that *Orobanche* infestation was mainly on tomato and potato in all farms causing serious yield losses (60%). The majority of farmers (60%) hand pulled *Orobanche* at flowering stage, 10% before flowering while 30% did not use control measures.

Most farmers grow tomato which constitute over 60% of the total cropped area and usually leave *Orobanche* plants in the field after crop harvest. They do not adopt a fixed cropping system or crop sequence. However, at Wad-Ramly Society a fixed crop sequence has been followed since 1998, and accordingly an *Orobanche* infestation gradually decreased and is at present *Orobanche* free (Table 1).

Table 1. Infestation of *Orobanche* and yield loss of tomato in eastern bank of River Nile.

Location	Cropping system	Infestation (%)				yield loss (%)			
		2004/05	2005/06	2006/07	Mean	2004/05	2005/06	2006/07	Mean
Halfaya	Monocropping tomato	100	100	80	93.3	80	90	60	76.66
Elkadaro	Monocropping tomato	80	80	100	86.6	70	60	70	66.66
Shambat	Monocropping tomato	60	100	80	80.0	65	70	40	58.33
Khogalab	Monocropping tomato	80	100	90	90.0	50	80	50	60.00
Elsagay	Monocropping tomato	100	100	100	100.0	50	60	50	40.00
Wawoosi	Monocropping tomato	70	80	60	70.0	80	60	40	60.00
Elgeli	Monocropping tomato	80	80	100	66.6	80	60	65	68.33
Wad- Ramly society	Wheat, onion, fababean, tomato	0	0	0	0.0	0	0	0	0.00
Wad- Ramly	Monocropping tomato	80	80	100	86.6	60	50	60	56.66
Abu Halima	Monocropping tomato	100	100	100	100.0	50	70	50	56.66
Fakki Hashim	Onion, alfalfa, tomato	10	0	0	3.4	30	0	0	10.10

Western bank of River Nile

The major hosts of *Orobanche* are potato, tomato, eggplant and pepper with potato being the main crop. Mean *Orobanche* infestation on this crop ranged between 55% in Khor Omer to 100% in Elshehenab, Karrari and Elgedab and mean yield losses were 53.3 - 68.3%. Response to questionnaire revealed that *Orobanche* infestation leads to serious yield losses in potato, no fixed crop sequence and only 10% of farmers did not use control methods while 90% usually hand pull the parasite but leave plants in the field after harvest.

White Nile banks

Cultivated land is annually flooded and farmers practice flood production system. Crops include Abusabeen, onion, barseem and eggplants. Eggplants represent 70% of the cropped area. Mean incidence of *Orobanche* in eggplants ranged between 85% in Lamab and 100% in other locations. Yield losses ranged from 53.3–63.3%. Farmers indicated that there are no proper crop sequences. Only 10% of the farmers controlled *Orobanche* by hand pulling, 10% used fertilizer to mitigate the adverse effects of *Orobanche* on crops and 80% did not use control methods.

Blue Nile banks

Mean infestation ranged between 2% in Elalafon to 100% in Soba east, Hudiba, Mahas Kotorang and Albiotat Nuba and yield losses ranged between 40 and 80% in all locations, except Elalafon (0%). Data, based on the questionnaire, indicated that farmers usually grow different crops, but do not follow a proper crop sequence. Major crops are tomato (33.3%), onion (19.3%), snake cucumber (15.8%), barseem (15.8%), carrot (5.3%), eggplant (5.3%), cucumber (khier) (1.8%) and okra (5.3%). Farmers indicated that eggplant and tomato were heavily infested with *Orobanche* and infestation was 88% on tomato, 10% on eggplant and 2% on pepper. Most farmers (89%) did not use control method, 10% used fertilizers to increase yield of the infested crops and only 1% hand pull *Orobanche*.

Agricultural schemes Alban Kuku, Soba- west, Om Arda, Waha, Elshaab, Ellellate and Gomea have different cropping systems. They are characterized by fodder production, mainly Abu-sabeen, alfalfa and vegetables include e.g. okra at Gomea scheme. Since all crops are non-hosts for *Orobanche*, no infestation or yield loss was found.

Table 2. Infestation of *Orobanche* and yield loss of potato in western bank of River Nile.

Location	Infestation (%)				yield loss (%)			
	2004/05	2005/06	2006/07	Mean	2004/05	2005/06	2006/07	Mean
Elshehenab	100	100	100	100.00	70	60	75	68.33
Karrari	100	100	100	100.00	65	70	50	65.00
Elsarorab	80	80	100	86.66	50	65	60	58.33
Elgedab	100	100	100	100.00	50	65	65	60.00
Khor Omer	65	50	50	55.00	70	50	50	63.33
Elsheikh Eltayeb	100	100	60	86.66	50	60	50	53.33

Table 3. Infestation of *Orobanche* and yield loss of eggplant along White Nile.

Location	Cropping system	Infestation (%)				yield loss (%)			
		2004/05	2005/06	2006/07	Mean	2004/05	2005/06	2006/07	Mean
Lamab	Diff. crops	75	80	100	85	60	60	70	63.3
Remella	Diff. crops	100	100	100	100	60	50	50	53.3
Elklakla	Diff. crops	100	100	100	100	60	50	60	56.7
Dekhaimat	Diff. crops	100	100	100	100	60	50	60	56.7

Different crops: eggplant, okra, tomato and barseem.

Table 4. Infestation of *Orobancha* and yield loss of tomato along Blue Nile banks.

Location	Cropping system	Infestation (%)				yield loss (%)			
		2004/05	2005/06	2006/07	Mean	2004/05	2005/06	2006/07	Mean
Bagair	Diff. crops	70	90	100	85.0	60	60	60	60.0
Soba East	Diff. crops	70	100	100	100.0	65	60	60	61.7
Hodiba	Diff. crops	100	100	100	100.0	65	65	65	65.0
Mahas Korrang	Diff. crops	100	100	100	100.0	40	60	70	56.7
Nuba Gerrif	Diff. crops	80	80	60	73.3	50	60	40	50.0
Kotrang Island	Diff. crops	80	100	100	93.3	50	>50	60	53.3
Elalafoon	Fixed crops sequence	2	3	1	2.0	0	0	0	0.0
Albiotat Nuba	Diff. crops	100	100	100	100.0	70	70	70	70.0

Different crops: cucumber, okra, eggplant, barseem, carrot, onion and tomato.

Fixed crops: onion- onion- Abusabeen- alfalfa- tomato.

Discussion

The results showed in all locations the species of broomrape was *O. ramosa*. The major hosts were tomato, potato, eggplant, carrot and pepper with tomato and potato being most infected. Severe infestation by *O. ramosa* has been reported in major vegetables producing areas of the Sudan (Babiker *et al.* 1993). It attacks a wide range of solanceaceous crops (Ismail, 1979, Adam, 1985). High incidences on vegetable crops in Khartoum state was also reported by Dongola, (1995-2006). Babiker *et al.* 2004 reported that *Orobanche* is a real problem River Nile and Northern states. In both banks of the River Nile infestation of *O. ramosa* on tomato was 60- 100% and yield losses amounted to 50-80%. Ismail (1979) and Dongola (1995) reported that high infestation lead to serious yield losses on Solanaceae crops which ranged between 90-100% in tomato and potato. Severe parasitism is attributed to the production system which is characterized by mono-cropping of potato and tomato, no fixed crop sequence is followed and improper control methods. However, some farmers hand-pull *Orobanche*, after flowering but usually leave plants in the field. However, at Wad-Ramly society a fixed crop sequence has been adopted since 1998 and infestation progressively decreased with time and is at present free of infestation.

Heavy *Orobanche* infestation does not only lead to crop failure, but make field soils *Orobanche*-sick for a long period, preventing reasonable production of legumes and vegetables in infested fields for several years. Failure of containing this parasite will be disastrous. In Northern State, tomato canning factory at Kariemeh was closed down, because farmers abandoned growing tomatoes due to *O. ramosa*. Infestation (Babiker *et al.* 1993). The potential problem is that farmers in heavily infested areas may abandon crop production and may be forced to migrate and seek other means of income outside the rural domains. Therefore, repeated annual monitoring is essential in infested or previously infested fields.

The rapid spread of the parasite is attributed to lack of awareness on biology of the parasite and possible means of management among farmers and personnel of the ministries of agriculture. Control of *Orobanche* has proved exceptionally difficult due to its ability to produce enormous number of seeds that remain viable in the soil for more than ten years. Such difficulty limits the development of successful control measures that can be accepted and adopted by farmers.

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