Solanum Elaeagnifolium: A New Invasive Weed in Lebanon

Mustapha Haidar  
Department of Agriculture,  
Faculty of Agriculture and Food Sciences,  
American University of Beirut, Lebanon

Weeds and invasive alien plants are a major threat to natural and agro-ecosystems in Lebanon and the Middle East (ME). Accordingly, early detection, mapping and active management of invasive alien plants such as *S. elaeagnifolium* are extremely important, particularly with the swift increase in global travel and trade, which accelerates weed invasion [2]. *S. elaeagnifolium* is a perennial broadleaved plant in the family Solanaceae.

It is one of the most noxious and fastest invasive spreading plants in many crops such as cotton and orchards. Control remains challenging for crop growers and it is included in the lists of plants controlled under noxious weed legislation in Australia, South Africa and approximately 20 states of the USA. In 2006, it was recommended for regulation in the EPPO region as an A2 pest [1]. An outbreak also occurred in Northwestern Iraq and in Jordan leading to farmers’ economical suffering [1]. Only recently did the Food and Agriculture Organization sound the alarm on this invasive non-native weed in the ME region.

Mapping of *S. elaeagnifolium* is considered the foundation for the development of a strategic long-term management plan to protect agro-biodiversity and prevent invasion of this non-native invasive alien plant. Surveying its spread in arable and non-arable lands of Lebanon is essential for identifying sources and means of distribution.

An invasive alien plants map is also beneficial in assessing the economic and environmental impacts of invasive alien plants and for their strategic management and monitoring. No similar studies on this subject have previously been conducted in Lebanon. Therefore, the objective of this work was to find out the status of *S. elaeagnifolium* in Lebanon and establish its first baseline data at the national level.

Materials and Methods

Ninety-five villages distributed between two governorates, namely; the Beqaa and the North of Lebanon governorates were surveyed all the way to the Lebanese Frontier (Figure 1). A global positioning system (GPS) Garmin© 2006 was adopted to take precise waypoint, elevation, navigation and distance. In addition, a vehicle device was extensively used to facilitate the quest of the two Weed and Environmental Scientist’s Researchers from the American University of Beirut institution team in going off-road for visual observation purposes in arable and non-arable lands (Box 1).

Alia Sabra  
Department of Agriculture,  
Faculty of Agriculture and Food Sciences  
American University of Beirut, Lebanon
The team consisted of a weed scientist (M. Haidar) from the American University of Beirut and his trained assistant (A. Sabra). Visual aid containing a collected sample of the alien plant, helped in the surveillance process when addressing to the locals including farmers and herders, to ensure the validity of the response and unify the language of the purpose. A digital camera was utilized to record evidence of visited villages.

Fifty-two villages in the Beqaa extended between Ebblias (N33° 78.021’, E35° 81.618’) and Qaa (N34° 34.874’, E36° 51.509’) were surveyed. In comparison, forty-three villages in the North expanded from Batroun (N34° 27.484’, E35° 65.904’) to Machta Hammoud (N34° 64.637’ E36° 33.181’). Target weed was $S. \text{elaeagnifolium}$ because it is an epidemic, highly invasive, nonnative weed in our neighboring country Syria [2, 3, 4].

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**Box 1**

Timeline of Operation for *Solanum elaeagnifolium* Surveillance

<table>
<thead>
<tr>
<th>Month</th>
<th>Phase</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2011</td>
<td>Phase I</td>
<td>Investigated arable and non-arable, industrial and marginal lands in the West, East, South and North of the Bekaa plain and the Libano-Syrian borders in the North of Lebanon reported a “<em>Solanum Free Zone</em>” - <em>Abutilon theophrasti</em> field at Hawsh Snayed in the Mi-Bekaa (First Indication)</td>
</tr>
<tr>
<td>December 2012</td>
<td>Phase II</td>
<td><em>S.elaeagnifolium</em> First Appearance and Intrusion in the North Beqaa plain (The percentage of coverage is between 1-5%, the frequency is 2 to 4 diameter in meter and the growth status is seedlings)</td>
</tr>
<tr>
<td>June 2013</td>
<td>Phase III</td>
<td>Investigated arable and non-arable, industrial and marginal, inland and coastal lands in the West, East, South and North of the South and the West-Bekaa plain of Lebanon showed No Sign for the existence of <em>S.elaeagnifolium</em></td>
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</tbody>
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**Results and Discussion**

Post the Syrian conflict, the investigated arable and non-arable, industrial, marginal lands revealed the presence of *S. elaeagnifolium* only in two villages in the North Beqaa governorate (Box 1). In comparison, *S. elaeagnifolium* was not found in any of the ecosystems in the North governorate. This finding was confirmed by farmers, nursery owners, and from the survey of several farms with a yearly crop rotation of barley, legumes and watermelon, or eggplants. These farms are situated between the Lebanese and Syrian borders in the Qaa village of the North-Bekaa governorate. This finding was also confirmed by several Lebanese shepherds, living in Baalbeck and Hermel villages’. Both villages are located in the North East-Bekaa governorate, who regularly takes their herds to the Syrian border to graze. This was also ascertained by few Syrian workers near the Syrian border at the North East-Bekaa plain. This collected data proved necessary when an outbreak of *S. elaeagnifolium* had previously occurred across the Lebanese border in neighboring Syria [2, 3].

It is also mystifying that the neighboring Syrian country is infested with *S. elaeagnifolium* while the North Lebanese frontier (North of Lebanon governorate) is free from this weed. Some farmers cited that *S. elaeagnifolium* appeared after the import of contaminated orchards (Large olives, stone fruit and apple) and vegetable seedlings from Syria two years ago. Accordingly, a needed preventive action-oriented plan should be adopted to keep Lebanese villages bordering the Syrian line intact from any future invasions.
Conclusion and Alien Plant Action Recommendation Plan

This is the first report of the introduction of *S. elaeagnifolium* in Lebanon and the establishment of a baseline data on non-native invasive alien plant of Lebanon. Our observations revealed that the propagation of *S. elaeagnifolium* began with the import of the contaminated orchard seedlings (soil). Thus, regular field surveying and mapping to include other governorates are necessary to track weeds movement in Lebanon. Field-validated research is needed to generate new technologies for combating the infestation of present and future invasive alien plants.

There is a concern that the presence of *S. elaeagnifolium* in the North and Midth of the Bekaa expands due to farmer’s lack of awareness, especially with the presence of a “Syrian refugee mess”, to reach the temporarily “Solanum Free Zones”. Furthermore, the probability of penetration through the International Blue Borderline via the Occupied Palestinian Territories is foreseeable.

This concern is amplified when noticing throughout the field surveys that the population was confounding Solanum with other similar weeds and mostly being inquisitorial about it. Therefore, there should be an urge in initiating the following plan against *S. elaeagnifolium* invasion especially when knowing that it will be a major epidemic pest threatening cash crops at the time of its germination and flowering. The beauty of Solanum flower can lead locals to increase its growth for ornamental purposes. The two scientists urge officials in Lebanon to consider *S. elaeagnifolium* as a quarantine pest. Different control techniques and methods are needed to prevent *S. elaeagnifolium* from entering Lebanon and spreading (Box 2).

**Box 2**

Control Techniques used at National and Farmer Levels

A - National Level

- Enhance public awareness on *S. elaeagnifolium* risks as it can be carried by herders at the border as a contaminant on footwear through the media (Press Conferences, TV Talk shows, Posters, Flyers, Newspaper, Magazines, Radio and the Internet)
- Establish a seed law by the Ministry of Agriculture
- Create Quarantines at the border allowing only the entrance of clean containers and packaging material into Lebanon
- Cleaning and disinfection of imported machinery and vehicles from countries where the pest occurs
- Sanitization of fields through usage of clean certified seed, clean equipment and tarping grain loads techniques

B - Farmer Level

- Educate farmers through lectures, trainings and workshops via establishing Farmer Field Schools (FFS) in main agriculture areas (Bekaa, North and South)
- Ensure the continuity of the project via training of trainers (ToT)
- Enforce Sterilization
- Integration of weed management system (IWM)

Bibliography / More information

Figure 1
The surveyed Beq'aa and North governorates
Figure 2
Explored villages in the Beqaa governorate of Lebanon