DISTRIBUTION OF THE SORGHUM HALEPENSE (L.) PERS. IN THE MARMARA REGION OF TURKEY

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Invasive alien plants and expanding native species, which have unpredictable but significant effects in ecosystems in many cases, cause huge and rising ecological, socio-economical and human health problems. Key points for precise and timely detection of invasive plants are: (i) history of spreading (vectors, pathways, introduction time etc), (ii) basic taxonomic and biological information, and (iii) distribution and status of the plants. Sorghum halepense is a Mediterranean element, i.e. a native plant of Turkey with impacts on managed and unmanaged areas in native and non-native ranges. However, there is still lack of information on S. halepense in different ecosystems and regions of Turkey. A project has been carried out to (i) map S. halepense at regional level, (ii) determine plant species established community with S. halepense, and (iii) examine factors causing high competitive ability. Thus, data obtained can be used to create a strategy from prevention to containment of S. halepense and, compare and assess behavior of the species in current and prospected invaded regions worldwide. In this paper, data from the Marmara Region of Turkey, where surveys were carried out in 28 different managed and unmanaged ecosystems in 11 provinces is presented.

Key Words: Sorghum halepense (SORHA), Marmara region, mapping, weeds

INTRODUCTION

Johnsongrass is a perennial grass species, considered native to the Mediterranean area (Holm et al., 1977) and Turkey. Johnsongrass is ranked as the sixth worst weed, which was reported by 53 countries as a weed in 30 different crops (Holm et al., 1977). It has been reported in industrial crops such as cotton and maize, wheat fields, vegetables, fruit plantations and waste areas in Turkey (Ulug et al., 1993; Zel, 1994; Uludag and Uremis, 2000). It was reported that 61% of cotton production areas were infested with SORHA in Turkey and impact of SORHA control is 165 million Euro (Gunes et al., 2008). Crop lost in cotton due to Johnsongrass interference was calculated 7% through 69% depending on Johnsongrass density 1 through 32 on 8 m of a row (Uludag et al., 2007). In a study fifty-one olive groves surveyed twice during 2003-2004 growing season. Ninety-two different weed species were determined which belong to 29 families. SORHA (81.60%) was the most common weed. Also, study identified widespread and intense, such as SORHA weed species, reaches a level of damage indicated that as a result of agricultural practices (Uremis, 2005). In another study weed species and densities detected of olive nurseries,
Edremit (Balıkesir) and Kemalpaşa (Bursa) districts in 1993, four different survey period was chosen. SORHA in Edremit was found with a frequency of 8.25% and a density of 22.2 plant/m²; and in Kemalpaşa 29.27% and 68.36 plant/m² respectively (Erten and Nemli, 1997).

According to a study weeds have a role within agro-ecosystems in supporting biodiversity. In this study a geo database was developed in order to store all the available information on Greek grasses. The grass species which are considered weeds in terms of their occurrence in Greek agricultural crops are the following in decreasing rank: *Lolium rigidum*, *Hordeum murinum*, *Poa bulbosa*, *Cynodon dactylon*, *Avena sterilis*, *Poa trivialis*, *Bromus sterilis*, *Phalaris paradoxa*, *Bromus tectorum*, *Phalaris minor*, *Lolium temulentum*, *Sorghum halepense*, *Alopecurus myosuroides* and *Lolium perenne*. This ranking is derived from 52 to 178 records each. One of the objectives of this survey is to bring together a selection of standardized vegetation data in a computerized databank. Such a databank will provide information on the floristic composition and geographical distribution of plant communities which will serve as a source for various applications. The information derived from the database will provide a scientific basis for a European vegetation classification by documentation of vegetation types (syntaxa) from an ecological point of view. It may also contribute to a European survey and management of grasses which could become problems as invasive species (Economou et al., 2011).

The lack of information on Johnsongrass in different ecosystems and regions of Turkey necessitates such studies. In this paper, data from the Marmara Region of Turkey, where surveys were carried out in 28 different managed and unmanaged ecosystems in 11 provinces, is presented. Thus, data were obtained can be used to create a strategy from prevention to containment of SORHA and, compare and assess behavior of the species in current and prospected invaded regions worldwide.

**MATERIALS AND METHODS**

The survey was carried out at SORHA flowering period starting early July to late September in the year 2011 in order to determine the prevalence and density. During survey; 11 provinces were covered in the Marmara Region. Area was considered in the Marmara region according to Flora of Turkey (Davis, 1965-1988) which is designated on a map of Turkey; A1 (Edirne, Kırklareli, Tekirdağ and Çanakkale), A2 (İstanbul, Yalova, Bursa and Kocaeli), A3 (Sakarya, Bilecik, Kocaeli), B1 (Balıkesir, Çanakkale) and B2 (Balıkesir, Bursa) squares system is located.

Survey focused in a 20 kilometer intervals, at the each occurrence of the stop areas (agricultural and / or non-farm) samples have been counted and recorded on a form. It was considered to take into account the samples of 0.1 ha in the areas of agriculture and in the 100 m² (20 m x 5 m) in non-agricultural areas. A four - times random counts of frames (0.5 m x 0.5 m) in each point SORHA plants were counted and recorded. The latitude, longitude, and elevation of each site were recorded using a handheld global positioning system (GPS) device, in the presence of SORHA at the site.

Survey data, SORHA encounter frequency (%) was calculated with the following formula;

\[
\text{Encounter Frequency (\%)} = 100 \times \frac{N}{m}
\]

\(N\): positive SORHA sampling
\(m\): Total number of sampling
In addition, the value obtained as a result of the counts divided by the total area density (plants/m²), thus density of SORHA was calculated. Each point with the Global Positioning System (GPS) a map was drawn to show the spread of SORHA in the region.

RESULTS AND DISCUSSION

In this study, both the general situation in the Marmara region was identified for the SORHA, as well as the control measurements to control it by farmers.

In 2011, observations were made in 11 localities from Marmara region including 27 different crops, nurseries and unsowed areas (grassland area, road verge and irrigation canal etc) were examined (Table 1). A total of 2623 samples taken from 167 points were marked with the GPS (Figure 1). SORHA plants were found growing in and around all localities. Sorghum plants encounter frequency (%) and intensity (plant/m²) of the region is presented in Table 1. SORHA was very common in all of the sampled regions at surveyed sites. Density in an m² and encounter frequency of SORHA ranged from 13 to 30 and 34 to 100%, respectively (Table 1). Even these data would give an idea of invasive characteristics of SORHA. Warwick and Black (1983) list S. halepense characteristics lending to its success as: (i) production of extensively creeping rhizomes, (ii) high seed production, (iii) rhizomes which regenerate easily when segmented, (iv) self-compatibility, (v) seed dormancy and seed longevity, (vi) vigorous growth rate in a wide range of environmental conditions, and under low light levels, (vii) plasticity when growing in a wide range of environmental conditions and (viii) great variability (contributing to S. halepense rapid adaptability to northern climates). Furthermore FAO notes that SORHA has good drought tolerance, with rhizomes surviving dry periods (Anonymous 1).

Figure 1: SORHA spread in Marmara Region (167 point marked)
Mowing, plowing, and herbicide applications were done to control SORHA, but it was observed that these applications were not successful.

**Mowing:** both to control and long-term management of grain reserves are useful for curbing the SORHA population. As reported by different researchers; Mowing Johnsongrass for several seasons weakens the plants and reduces rhizome growth (McWhorter, 1981). Removing aerial grass shoots close to the ground is a technique used to exhaust the stored carbohydrates of perennial weeds (Horowitz, 1972). Horowitz (1972) reports that clipping three week old seedlings will kill them, whereas McWhorter (1961) claims that seedlings must be clipped within 14 days after emergence for death of the plants to occur. As compared to the single clipping of seedlings, plants arising from rhizomes require two clippings within the first two weeks of growth to insure death of the plant (McWhorter, 1961). Because the lowest rhizome carbohydrate concentration occurs in the spring, during initial above-ground growth, and in the fall, during over-wintering rhizome formation, clipping at this time will have the maximum controlling effect by preventing the formation of photosynthesis and thus precluding a stored energy supply (Horowitz, 1972). However, this method is useful only for reduction of seed production in the Marmara region, because; (i) timing of the mowing and (ii) only one time mowing in a season, there was no mortality of SORHA was observed.

**Plowing:** usually were applied in the orchards, but SORHA density and the distribution within the ploughed area were noticed by the farmers. This situation is a result of incorrect timing of plowing, the loss of apical dominance, transportation by equipment used and insufficient numbers of plowing to be done within a period. The studies confirm these observations. Halvorson and Guertin (2003) notes that rhizome fragments as small as 1 in. (2.5 cm) can produce new plants from a soil depth of 4 in. (10 cm). In fact when a heavily infested site was thoroughly tilled 6 times at 2 week intervals over the growing season, rhizome production was reduced by over 99% (McWhorter, 1973). Also reported by Newman (1993); the optimum time to begin control efforts is during the first two weeks of growth; new rhizome development has not begun and carbohydrate reserves are at their lowest.

**Herbicide applications:** were observed to yield insufficient control in the Marmara region. These unsatisfactory results are due to: (i) mistiming of the application (ii) and repeated use of the same active ingredients. Treating Sorghum halepense with herbicides to insure effective control requires several applications with proper timing (Anonymous 2, 1999). The prolonged use of the same herbicide can cause problems of herbicide resistance,
a phenomenon consisting in the selection of resistant weed population of a previously fairly well controlled by the same herbicide (Palou et al., 2008). In addition, Sorghum halepense resistance to herbicides: as acetolactate synthase (ALS) inhibitors (imazethapyr, nicosulfuron), acetyl-CoA synthase carboxylase (ACCase) inhibitors (clethodim, fenoxaprop-P-ethyl, fluazifop-p-butyl, quizalofop-p-ethyl, sethoxydim), dinitroanilines and others (pendimethalin) (Anonymous 3).

One type of control method is not effective for SORHA. First of all surveys should be carried out to determine the level of invasion, and then the control methods can be planned. In addition, measures should be taken within the scope of integrated weed management.

The most efficient and effective method of managing invasive species such as the Johnsongrass is to prevent their invasion and spread. Also, on the Integrated Management, a combination of complementary control methods may be helpful for rapid and effective control of Johnsongrass. Integrated management includes not only killing the target plant, but establishing desirable species and discouraging nonnative, invasive species over the long term (Anonymous 4).

In this study, SORHA’s general situation throughout the region was determined. The data collected can be utilized as a beginning of a data bank. It may also provide a source for the future studies. It will be useful: (i) a training facility for the region, (ii) to determine SORHA herbicide resistance and (iii) SORHA regional invasion situation should follow-up.

Therefore, there is a need to plan adequate control programs for SORHA in Marmara region.

REFERENCES


