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ORIGINAL ARTICLE

Soil seed bank and seed germination of sand dunes vegetation in North Sinai – Egypt

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Abstract This study was carried out during two years 2007 and 2008 in three sites (microhabitats) of sand dunes i.e., El-Hauol, El-Gapher and Magaria located in North Sinai, Egypt to clarify the ecological factors affecting sand dunes vegetation. Sand dune location, dune levels (interdune, foot, flank and crest), directions (windward and leeward) and the effect of storage period of soil seed bank under room temperature on number of seedling emergence/m^2 and survival of the natural vegetation growing on sand dunes ecosystem and some edaphic factors such as (soil moisture %, soil particles size distribution and some chemical characteristics) were investigated. The simple correlation coefficients between some tested factors were also computed. The results indicated that the microhabitats significantly impacted the distribution patterns of the number of seedling emergence/m^2 in soil seed bank during the two years of study. Ecosystems may have different patterns because vegetation and soil seed bank can affect each other. The number of seedling emergence/m^2 in soil seed bank increased with increasing the period of soil storages under room temperature during the two years. The period of the soil storage had a significant effect on the number of seed germination. The dune locations, directions and levels must play an important role on soil seed bank and seed germination. Also, seed germination was affected by soil physical and chemical properties. There were 54%, 34% and 12% of seed emergence; respectively, in El-Hauol, El-Gapher and Magaria in the first year and 70%, 24%, 6% in the second year. There was highly significant simple

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correlation coefficients and positive relationship between some edaphic factors and number of seedling emergence/m^2 in soil seed bank.

Introduction

Soil seed bank has generally been defined as the amount of viable seeds present in the soil of defined area. Soil seed banks have been studied in various ways in various habitats, including arable soil, pastures, natural forests, forest plantations, lake shores, freshwater tidal marshes, salt marshes, prairie glacial marshes, deserts and sand dune. On the basis of studies on relationships between latitude and the number of buried seeds in the soil, it does not appear to be a latitudinal trend in density of the buried seeds. It is concluded that there are four types of seed banks and three kinds of seed banks which are similar basically according to some research data. In frequently disturbed habitats the species composition of the seed banks and vegetation was usually similar. As the vegetation matures, the disparity between these two increased. Acknowledgement of the seed bank is of great value in agriculture, forestry, conservation management and revegetation of mining wastelands.

A soil seed bank is considered to be persistent when the dispersed seeds remain viable for more than one year. As a property of a species, persistence refers to the ability of that species to survive in the soil seed bank. Seed persistence has been demonstrated in many flora/ecosystems around the world, including the desert in Arizona, USA (Philippi, 1993), the northwest European flora (Thompson, 1993), Mediterranean old-fields in France (Lavorel et al., 1993), and Argentina mountain grasslands (Funes et al., 1999). Persistence has received much attention in the literature. The relationships between seed mass, shape, and persistence have become a favorite topic and the source of much controversy recently. Previous studies have reported three different patterns to these relationships, with a conclusion that the species with persistent seeds have significantly larger seeds than species with transient seeds (Yu et al., 2007). However, species with small and/or round persistent seeds were relatively common. The underlying mechanism proposed for the observed pattern is a high proportion of large-seeded, persistent species with hard seed coat dormancy and abundant litter on the surface of the soil.

Fore dune perennials show variable responses to burial (Ehrenfeld, 1990), but a large majority exhibits an increase in vigor in areas with regular sand accretion. Increased vigor may be defined as an improvement in growth characters (physiological, ecological) of an individual plant and (or) increase in density, cover, and biomass per unit area. (Maun, 1996), and other fore dune species are found in areas with recurrent sand accretion rates of about 1–25 cm per year (Maun and Baye, 1989). Artificial burial experiments confirm that burial in sand is rate dependent and differs between species and life forms (Maun, 1996). The emergence of seedling from a burial deposit primarily is dependent on the energy reserves in its storage organs and the speed, depth, and frequency of burial sand (Maun, 1998). Many workers have investigated the soil seed bank (Yan et al., 2005, 2009; Zaghloul, 2008; Yu et al., 2003, 2007; Liu et al., 2007; Li et al., 2004).

The aims of this study are to clarify the effect of storage period of soil seed bank under room temperature on number of seedling emergence/m^2 and survival of the natural vegetation growing on sand dunes ecosystem.

Materials and methods

The study was conducted between November 2007 and June 2008, during two seasons as follows:

(a) *Autumn season 2007:* The soil samples were collected throughout the first week of November.
(b) *Spring season 2008:* The soil samples were collected throughout the last week of June.

Study site: Three sand dunes located in North Sinai, Egypt as follows:

Location	Latitude (around)	Longitude (around)
(I) El-Hauol	30°57′17″ North	32°55′09″ East
(II) El-Gapher	30°52′32″ North	32°40′20″ East
(III) Magaria	30°52′07″ North	32°28′54″ East

Every sand dune was divided into two directions, i.e., windward direction and leeward direction, and four levels of every one namely: ''Interdune area'', the flat area between dunes, ''Foot'' the base of the dune, ''Flank'' the middle of dune height and, its top ''Crest''.

Climatic factors (Table 1)

Climatic data were collected from Bir El-Abd meteorological station, which is the most nearest station to study site.

The study area has hot and dry climate in the summer months whereas it is cold in the winter. The average maximum temperature is 33.8 °C during July, while the average minimum one is 8.1 °C during January and the mean average is 20.973 °C during the year. The air relative humidity (%) ranged between 68% and 72% during the year. Estimated total rainfall is 40.32 mm/year and the most of rainfall was during autumn and winter months. The maximum wind speed is about 21.8 (km/h) which has an important impact on the dynamics of seed vegetation in this sand dunes area and the dominant wind direction is north. Evaporation ranges from 4.1 mm/day in December to 11.1 mm/day in July.

Edaphic data

The study of edaphic factors was carried out on soil samples collected from sand dunes {72 samples at three dunes, two directions, four levels, one depth and three replicates}.

Analysis of soil samples

The collected soil samples were subjected to the following analysis: