Agricultural Research Organization
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Use of coal ash to stabilize soil surfaces for the prevention of erosion damage in sandy soil by enhancing development of biogenic crusts

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Background

The sandy soils in the northern Negev are naturally stabilized by biogenic crusts (formed by photosynthetic microorganisms) that have not been exposed to anthropogenic (caused by humans) disturbances. Recently, 20 square kilometers of the sandy dunes, situated in the northern part of the Halutza sands, south of the Kerem Shalom district, was prepared for agricultural settlements. Extensive land tracts in the area, are composed of stable sand dunes, have and are still undergoing development and preparation for agricultural purposes. The preparation of areas for agricultural development involves leveling the surface with heavy equipment. This affects the soil surface natural stability, and exposes the agricultural land to wind erosion and to sand migration from the nearby dunes to the cultivated land. The migration of sand grains, which damages the crops and vegetation, has severe economic implications.

Fig. 1: Sand migrating into irrigated areas.

Fig. 2: Planted area covered by migrating sand.

Fig. 3: Agricultural crop (peanuts) covered by migrating soil.

Stabilized sandy soil surface contain more clay and silt relative to that found in migrating dunes. This contributes considerably to the development of biogenic crusts that stabilize the dunes. In this study the researchers' hypothesis is that the use of fly ash, which is rich in particles from the fine clay and silt segments, will help create conditions that contribute to the stabilization of the soil surface in dunes adjacent to agricultural areas. This is in order to enhance the development of biogenic crusts and restore the natural balance. The re-stabilization of the sandy surface in areas suffering

from imbalance will contribute to reducing the damage to adjacent agricultural areas and their crops.

The exploitation of coal ash to improve agricultural soils is well known and is documented in scientific publications and numerous applications, including a study commissioned by the Agricultural Research Organization (ARO) of the Institute of Soil, Water and Environmental Sciences at the Volcani Center, a few years ago. The Volcani study demonstrated the benefits of using fly ash in a field experiment to prevent the cracking of clayey sodic soil (Revadim field) and the improvement in the filtration of water in shrubs and limans in the loess soil (KKL forestation at Ketef Betarim, northeast of Be'er Sheva).

The stabilization of migrating sands is usually carried out through the planting of trees and bushes to serve as windbreaks. This method is common in areas in which the annual precipitation is greater than 300mm. In the Halutza area, where the annual precipitation is lower than 150mm, the plant growth is dependent on irrigation over a lengthy period and the absence of severe weather events (drought and storms). The biogenic soil crusts, on the other hand, maintain themselves at an ecological balance with their environment over time.

The cost of using ash alternative (transport, dispersal and insertion) approximates the direct cost of planting and maintaining bushes for a year and their future removal in order to restore the area to its agricultural designation (NIS 2,000-2,500 per dunam [1,000 square meters]). In this study we will test the assumption that the stabilization process using coal ash is much shorter than that required to grow bushes and has a greater chances of success, the contribution of the formation of biogenic crusts is expressed mainly in the shorter time period in which the agricultural plots are exposed to the damage posed by migrating sands and their resilience over time. This damage could cause the partial or complete loss of a harvest estimated at NIS 3,000-4,000 per dunam per year or impair its quality. When multiplied by the tens of thousands of dunams that are affected, even partial damage can total millions of shekels per year.

Research program

The study will include physical, chemical and biological tests to examine the effect of adding coal ash to the sandy layer on the development and stabilization of a biogenic crust and the efficiency of how it functions in the field, in two principal stages:

Preparatory stage: Laboratory experiments to prove feasibility and to determine the optimal concentration of coal ash that contributes to the creation of a viable biogenic crust.

Field experiment: Testing for applied feasibility in experimental plots in the area where agricultural land is being prepared in the Halutza sands. The feasibility test in the field will be carried out over a period of two years and will include the addition of coal ash to the experimental plots at the optimal level as obtained in the laboratory experiments. The preparation of the land for the experimental plots will begin parallel to the lab tests.

Timetable

Preparatory stage – Six months.

Field experiments – Two years.

Researchers

The Agricultural Research Organization (ARO) Volcani Center – The largest institution in Israel dealing with agricultural research and among the best known in the world; its main role is to help Israeli farmers solve various problems they encounter; to plan and carry out R&D in new strategic areas in agricultural and food sciences; to organize and carry out agricultural research in Israel. The researchers of the ALO teach in institutions of higher education and advanced agricultural courses for participants from Israel and abroad.

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