# New concept "Cloud Dusting",

# Analogous to land irrigation.

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## 1. Abstract

It has been shown that under certain conditions clouds can act as a source of bioavailable iron. The reaction scheme is initiated by wetting of the bacterial and fungal content of the desert origin dust and its subsequent release of oxalate as an osmosolute. We propose that the release of oxalate is deliberate as to attach the bacteria and fungi on to the clay mineral as to form ironoxalate. If the solar radiation is above some threshold level for given latitude the decarboxylation reaction takes place and iron is reduced to its +2 oxidation state. Upon collapse of the lattice structure some other bioavailable elements like those that Zn and Mn also released. We propose that this mechanism enhances the biological activity within the clouds analogous to land irrigation. Since we have the technology to seed the clouds with the right combination of dust at right time period we can enhance the biological activity hence the bioavailable iron within the clouds and upon its wet deposition over the land we can enhance the natural systems.

## 2. Introduction

The essential role of land irrigation on the agricultural production is beyond any discussion. Due to constant increase in world population demand for sustainable food supplies is becoming one of the topics, which will eventually, linked to environment and security on a global basis. Due to its vital role on the crop production any improvement on land irrigation techniques became very important issue especially for those regions who suffers or most likely to suffer from water shortage. Wet precipitation as snow or rain is a vital source of fresh water that may be used directly or indirectly for land irrigation purposes. Wet precipitation is at present entirely governed by seasonal meteorological conditions although there have been efforts as to induce artificial precipitation through cloud seeding by various chemical agents. In modern agricultural activities land irrigation is performed through man-made systems or networks. Nations who is most likely to suffer from imminent water shortage developed technologies that utilize water in the most efficient means. In this endeavor, Israel plays an essential leading role.

Here we present a new approach that may add a new perspective to both man made and natural irrigation systems. The hypothesis bases on so far unknown concept of dust cloud interactions. If we let the soil to get dry eventually, through some physical erosion stages we do create very small sized particles and dust having exactly similar mineralogical and chemical compositions with that specific soil. Through some meteorological events its possible to uplift, transport and mix that soil particle having less than 10 micron or smaller size with water droplet that exists within the cloud droplet. Thus, we do propose that similar to land irrigation this process leads to an event, that we named as "Cloud Dusting", which should result with similar products of land irrigation. In other word whatever we can

expect from land irrigation should also reflect itself into to the clouds. "Cloud Dusting" should have further advantages since it has the potential of producing bioavailable iron within the cloud droplet as explained by Saydam and Senyuva(2002).

## 3. Experimental

Although we have not yet performed, cloud seeding experiments the tests carried out at laboratory scales were very successful. As explained by Saydam & Senyuva(2002) the possible selective formation of bioavailable iron by using desert dust has been illustrated by irradiating soil samples imported from northern Sahara (south Tunisia), Saudi Arabia (near Riyadh) and various Anatolian, so called fertile, soil samples. The results have shown that during irradiation it is possible to observe the photochemical formation of Fe(II) and in addition the release of some other essential micro nutrient elements like, Zn(II) and Mn(II) likely to be originated from the decomposition of minerals following the phothochemical release of iron as illustrated in Figure 1. The photochemical formation of Fe(II) has reached a steady state within 120 minutes. To illustrate the effect of light on the formation of Fe(II) the irradiation terminated at 150 minute and the entire system kept at dark. Gradual decrease in the Fe(II) concentration observed after two hours due to possible oxidation of Fe(II) to its stable state of Fe(III). Similar experiments carried out by using various other soil samples and it has been further demonstrate that photochemical production of Fe(II) is limited to soil samples obtained from northern Sahara whereas soil samples obtained from Arabian Desert resulted with an order of magnitude less Fe (II) production and supposedly fertile soil samples representing various parts of Anatolia resulted with practically no Fe(II) at all as illustrated in Figure 2.

Similar irradiation experiments and subsequent release of $SO_4$ measured by using various other soils obtained from other parts of the region. The results clearly indicated that upon irradiation the Saharan desert soils produce by far the largest amounts of sulfate and sulfate particles are known as the best cloud condensation nuclei (CCN) as shown in Figure 3. Charlson, et al.,(1987); Charlson, R. J. and Wigley., (1994).

## 4. Discussion and Recommendations

The results of our experiments shows that upon contact with cloud droplet the desert dust and its bacteriological content can lead to series of reactions that may result with the formation of bioavailable iron at a given latitude provided that the solar radiation is above some threshold radiation. It has been further shown that the bioavailable iron is unstable and can start to oxidize back to its stable form within two hours. But, within this time sulfate particles also enhanced possible due to dissolution of Gypsyum and enhance cloud formation and may also enhance wet precipitation. Such events may introduce iron to the environment something that is essential for the synthesis of chlorophyll and heme. So far the scientific community devoted itself to soil and plant related processes as a potential source of iron. But for the first time ever, we are suggesting that clouds can be a potential source of bioavailable iron and we have the technology to seed the clouds with proper composition of dust and enhance the formation of bioavailable iron through a process that we named as "Cloud Dusting". This process not only enhances the clouds with bioavailable iron but also introduce particles in the Earth's atmosphere acting as condensation nuclei's originates as small ice particles or small cloud droplets. These particles grow by vapor deposition and coagulation and subsequently fall out as snow or rain if their special nuclei having a crystallographic relation to ice. Desert dust transported to on a global scale to various directions may bring nuclei of both types to influence precipitation under specific conditions. We have further shown that amongst the analyzed soil samples the privilege of both sulfate and bioavailable iron production capacity linked with the Saharan desert dust samples only and the so called fertile Anatolian soil samples failed to produce such precious chemicals. Even this result may leads to the re-definition of deserts.

## 5. References

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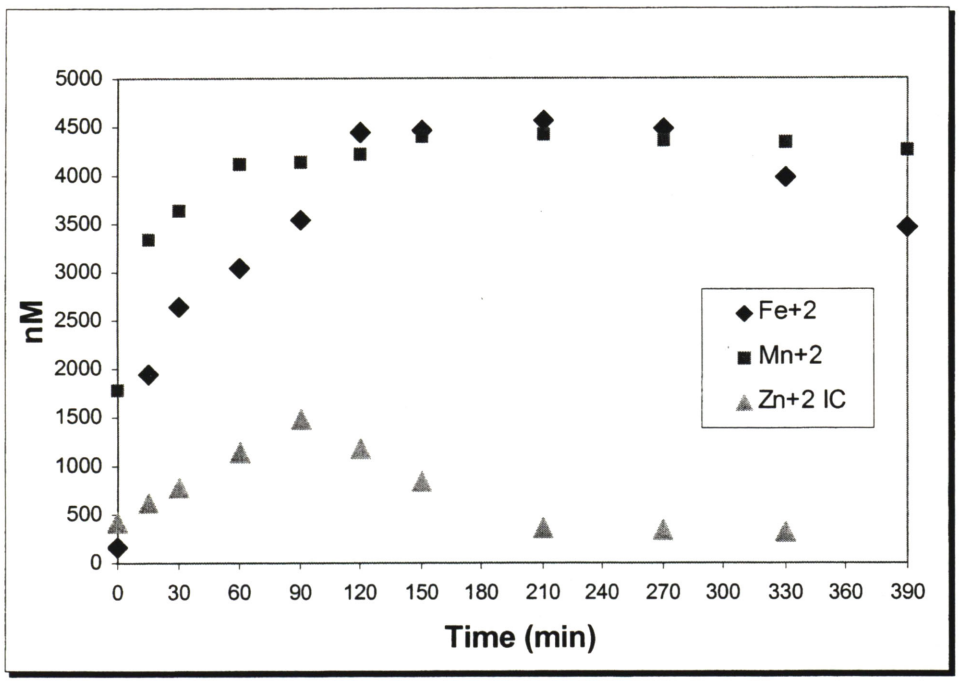


Figure1. The photochemical formation of Fe(II), and the production of Mn(II) and Zn(II) at pH 2-3 at constant temperature by using 10g of Sahara soil sample dry sieved through 30μ mesh in 500ml deionised water. Irradiation terminated at 210 min and the entire system kept at dark at constant temperature.

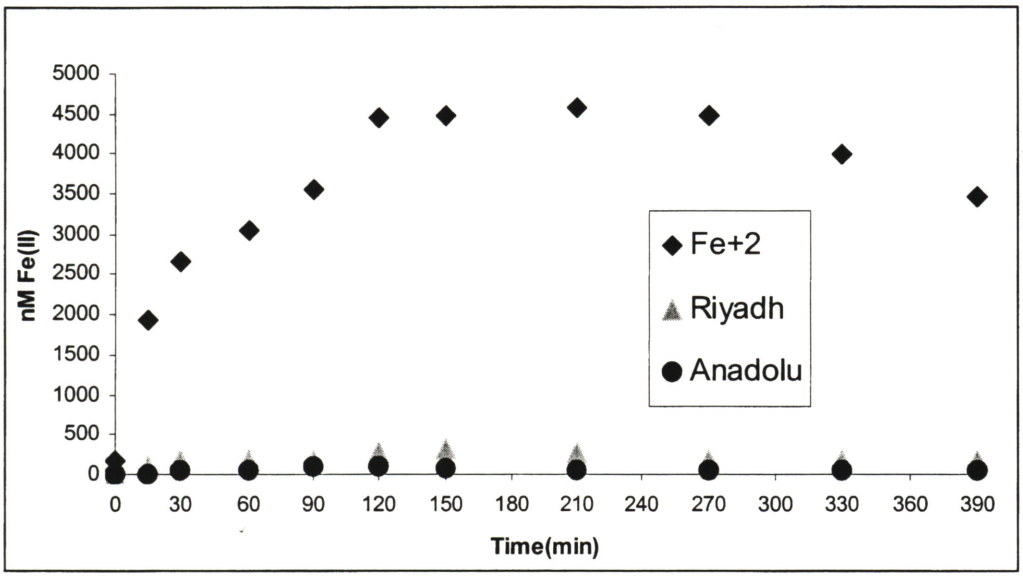


Figure2. The photochemical production of Fe (II) by using different samples from various geographic regions. Irradiation was terminated at 210$^{th}$ minute and the entire system was kept in dark.

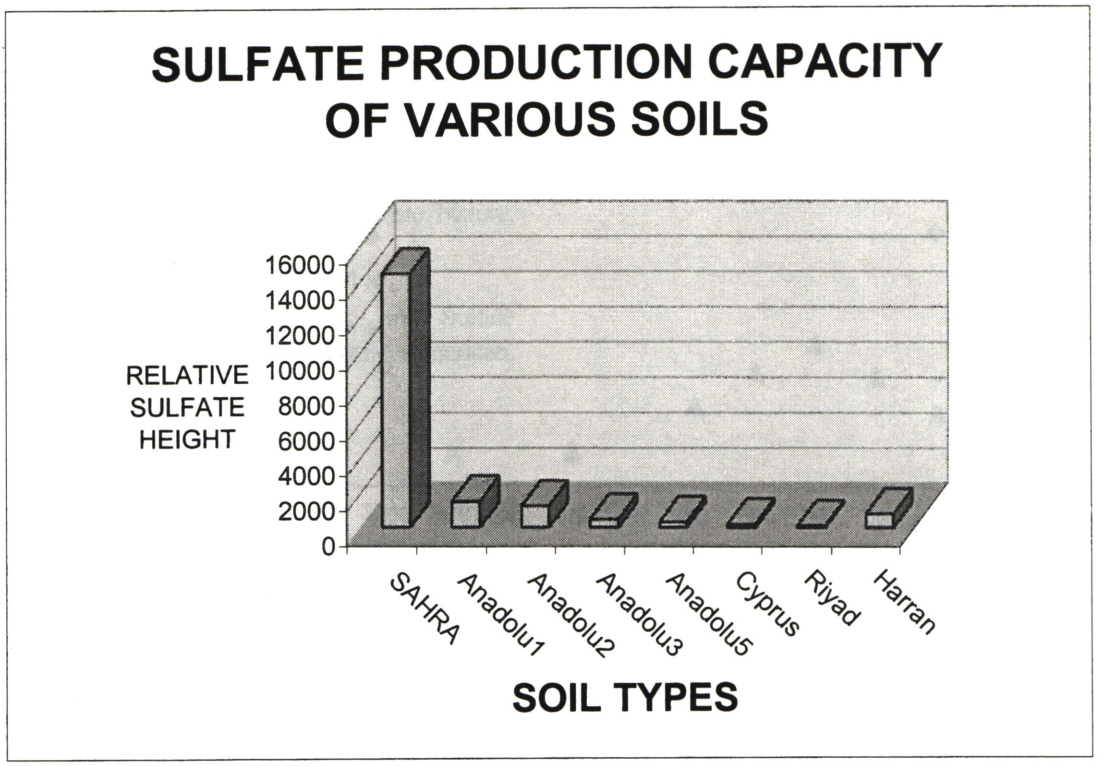


Figure3. The light induced production of Sulfate by various soil samples.