Crop management under salt affected soils

أدارة المحاصيل الحقلية في الاراضي المتأثرة بالملوحة

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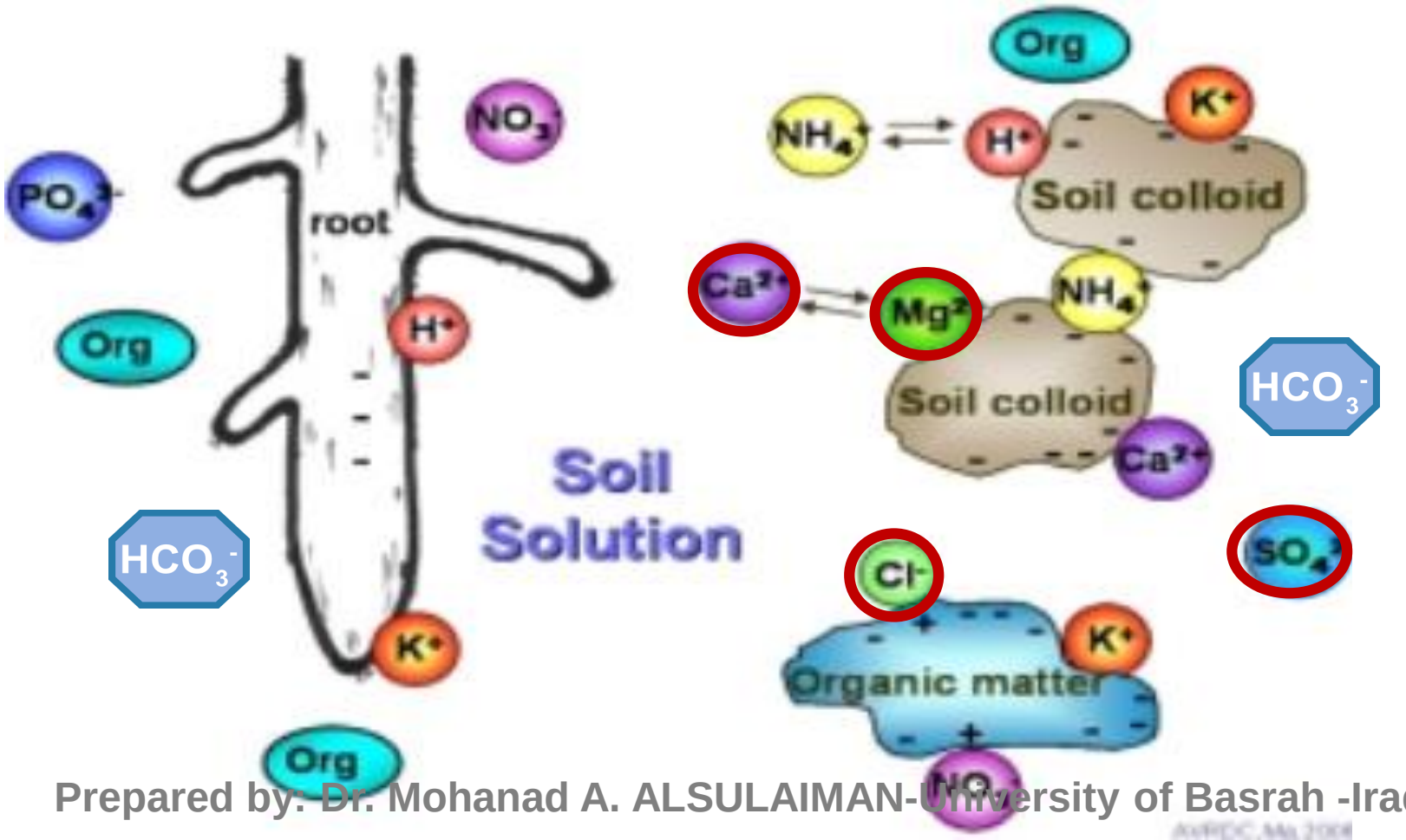
Syllabus مفردات المحاضرة

- Definitions and forms of salinity
- Sources of soil salinity
- Soil classification depend on salinity
- Distribution of salt affected soils in the world
- How to feed the world in 2050
- Multiple biotic and abiotic stresses in Field Condition
- Climate condition change impacted Agricultural production
- Effect of salinity on plant growth and yield
- Crop management under salt affected soils
- Conclusion

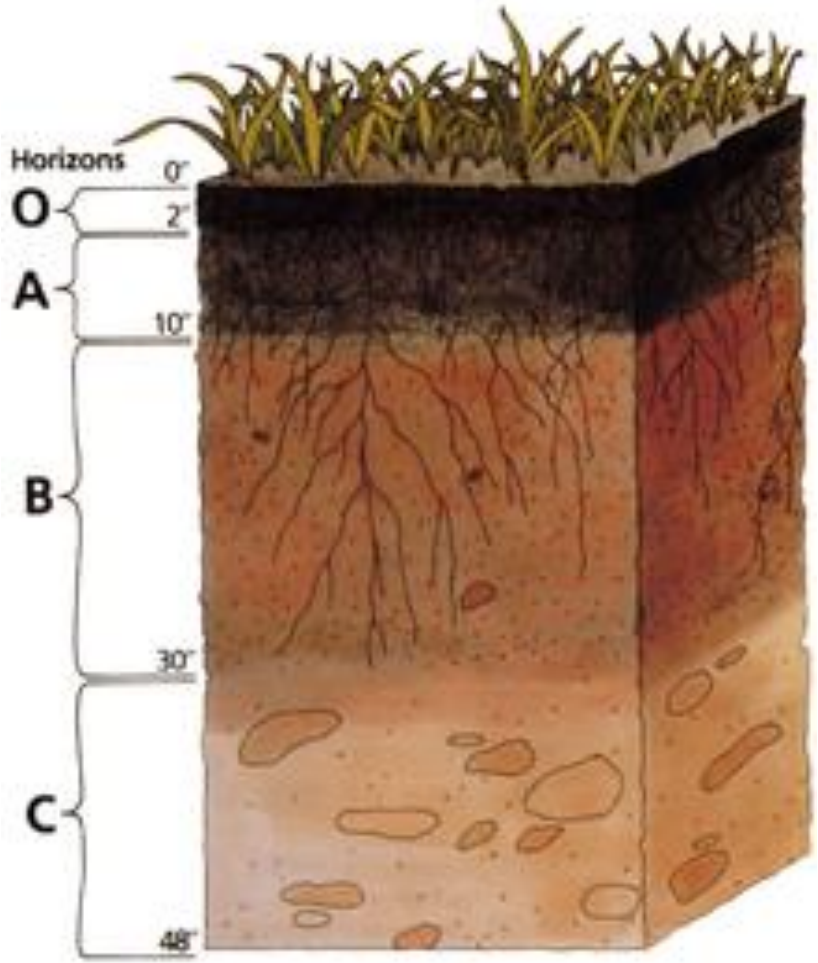
Definitions and forms of salinity

- Soil salinity: is the amount of dissolved salts in the soil solution.
- Salinization. The process of accumulating soluble salts in the soil is known as



Sources of salinity

- Naturally present as products of geo-chemical weathering of rocks and parent materials
- Underground water movement which have high concentration of salinity
- Caused by irrigation mismanagement, particularly when internal soil drainage is impeded.



Classification of salt affected soils تصنيف الاراضي المتأثرة بالملوحة

تم تصنيف الاراضي بالاعتماد على النباتات الحساسة للملوحة . فقد وجد ان النباتات الحساسة للملوحة تبدا بالتاثر عند 2 EC بالتالي تم اعتماد هذا الرقم للتمييز بين الترب الملحية و غير الملحية

تم تقسم الاراضي المتأثرة بالملوحة الى :

تقسيم الأراضى حسب درجة ملوحتها معبراً عنها بالتوصيل الكهربائى للمستخلص المائى لعينة منها عند درجة التشبع		
القسم	قيمة ال (Ece) دس / متر	تأثير الأملاح
١	أقل من ٢	أرض لا تحدث أى ضرر للنباتات
٢	من ٢ إلى ٤	أرض يحدث فيها ضرر للنباتات الحساسة للأملاح.
٣	من ٤ إلى ٨	أرض يحدث فيها تأثير على معظم النباتات.
٤	من ٨ إلى ١٦	أرض لا ينمو فيها سوى النباتات المقاومة للأملاح
٥	أعلى من ١٦	أرض لا ينمو فيها سوى النباتات شديدة المقاومة للأملاح.

لماذا نهتم باستغلال الاراضي المتأثرة بالملوحة في الزراعة ؟؟؟

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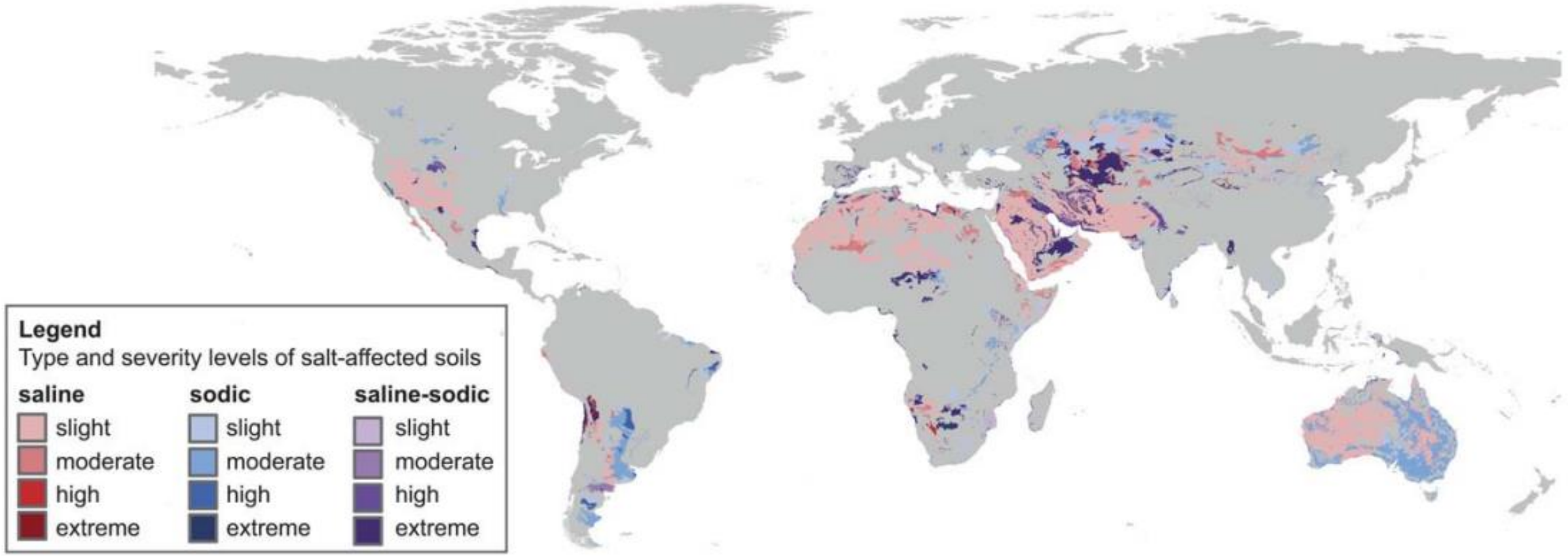
Firstly: Salt-affected soils is very extension during the current century



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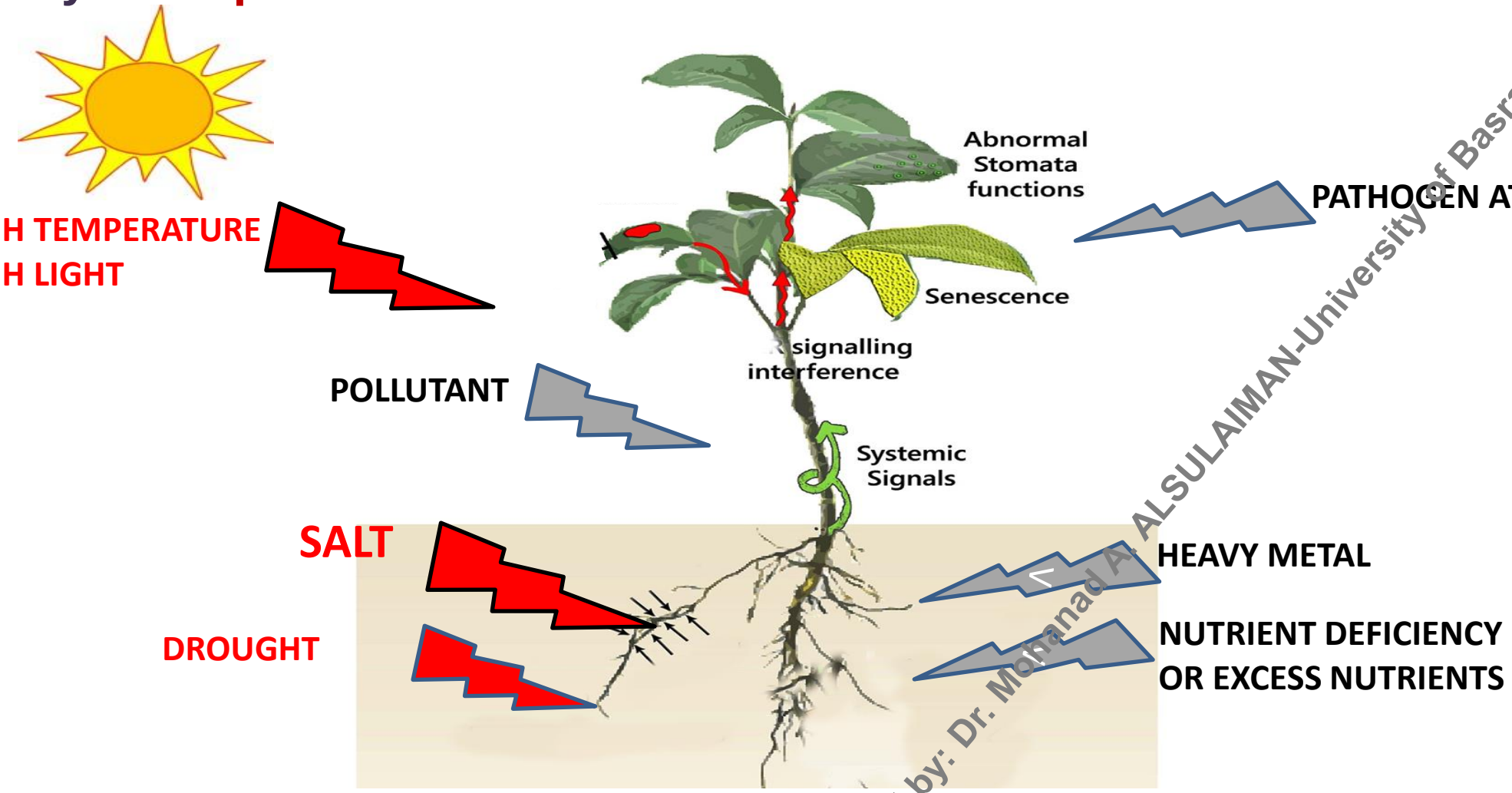
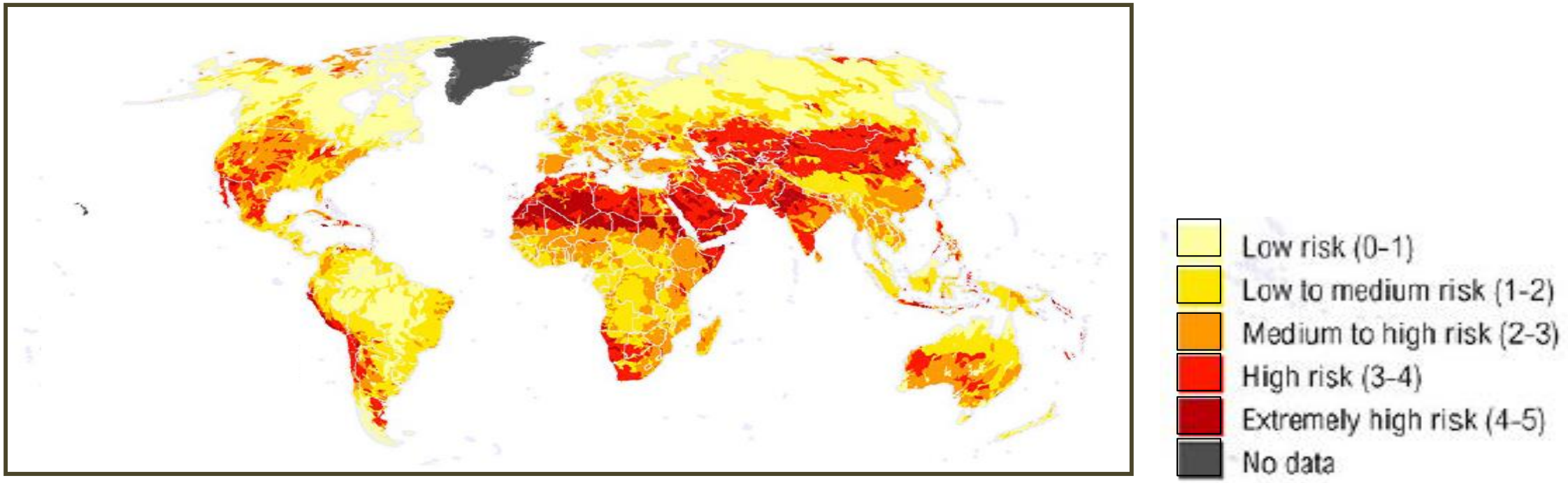
Secondly: Multiple biotic and abiotic stresses in Field Condition



Adapted from Kissoudis *et al*., 2014

Silt stress is associated with additional stress like Drought and/or High Temperature

Thirdly: Climate Condition change impacted Agricultural production

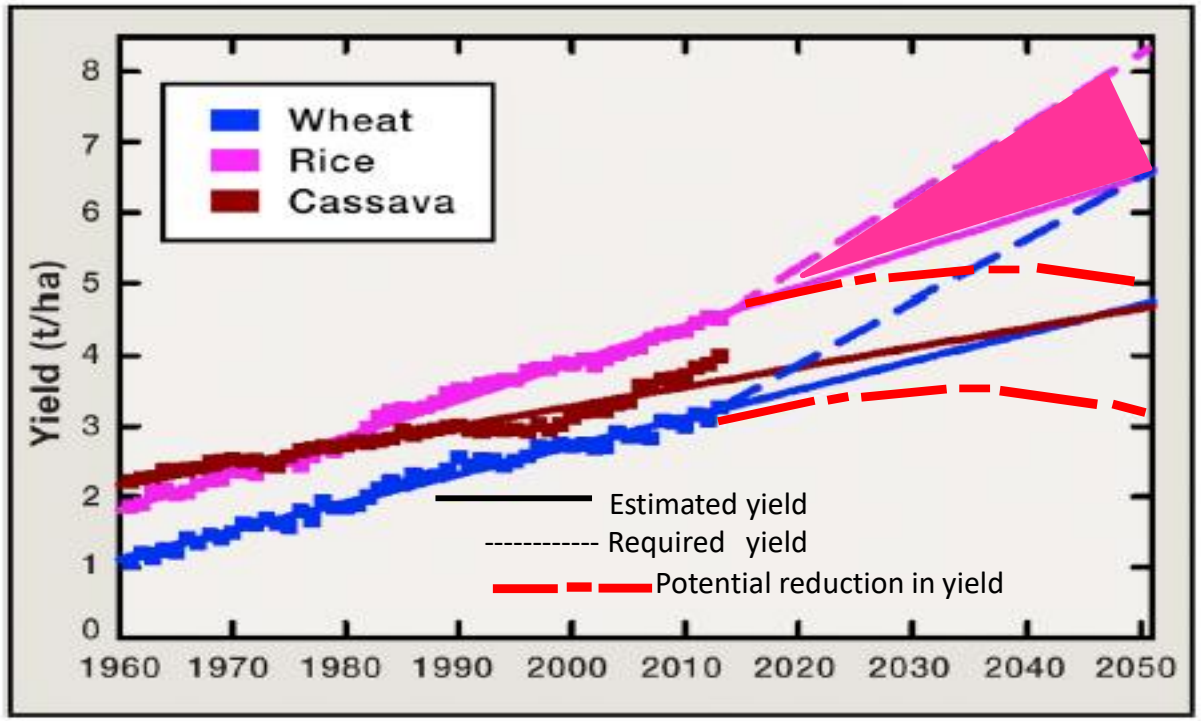


Risk of reduced water availability is present in almost all world lands

التغيرات المناخية مثل ارتفاع درجات الحرارة والجفاف والذي عادة يؤدي الى التملح

World Resources Institute, Working paper, April 2015

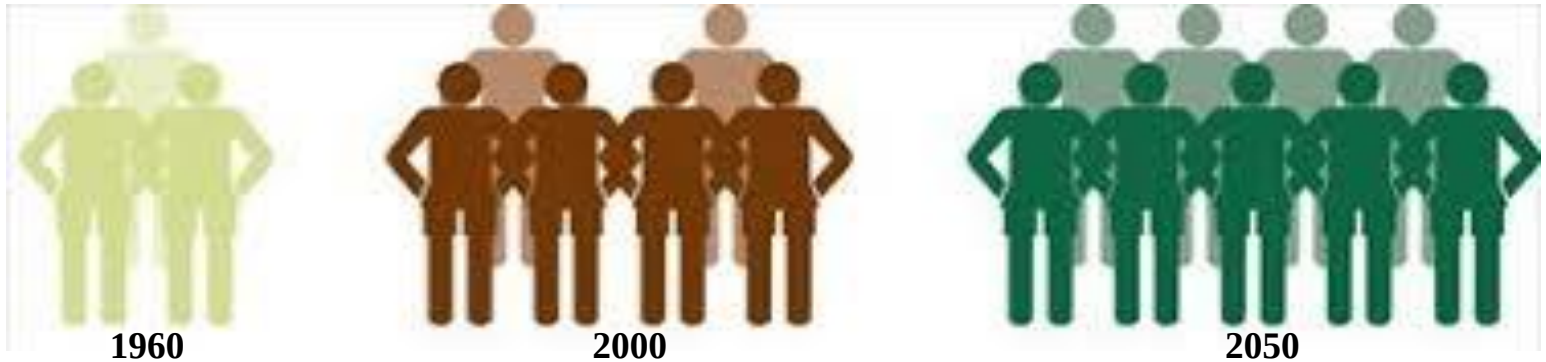
Global food demand will increase by 70–110% in the next future



Long *et al.*, 2015

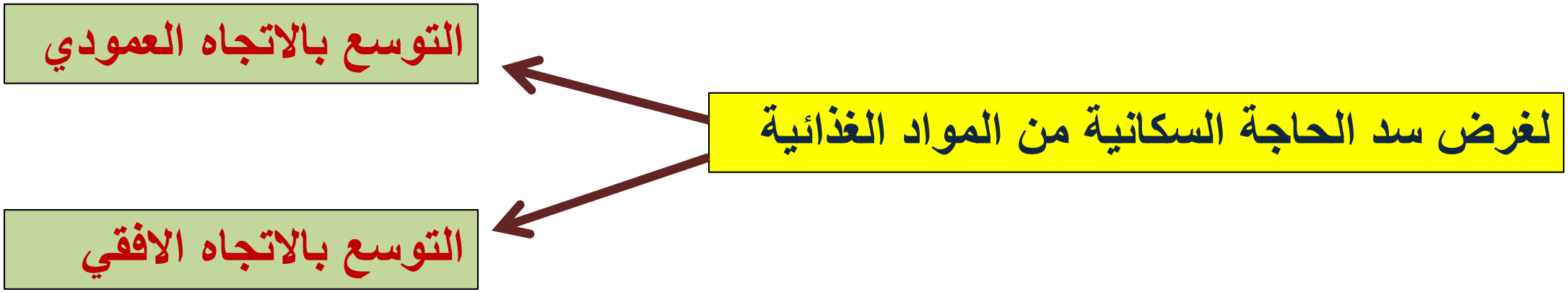
تدهور الاراضي الزراعية بسبب الممارسات الزراعية الغير صحيحة

How to feed the world in 2050? Global Food demand increase by 70–110%



Gupta and

The Conclusion الاستنتاج



Indicators of Soil Salinity كيف يتم التعرف على الترب المتأثرة بالملوحة

Salinization can be noticed visually by :

- **Analyzing the soil surface**
- **Speed of water infiltration, and vegetation state**
- **Plant withering**
- **Crop loss**
- **Appearance of salt-tolerant plants in the area and their further dominance.**

Salinity measurement and unit conversion كيف يتم قياس الملوحة وماهي وحداتها

Soil and water salinity is often measured by:

Electrical conductivity= EC or Total Dissolved Solids= TDS

1.TDS (mg/L or ppm) = EC (dS/m) x 640 (EC from 0.1 to 5 dS/m)

2.TDS (mg/L or ppm) = EC (dS/m) x 800 (EC > 5 dS/m)

Negative effect of salinity

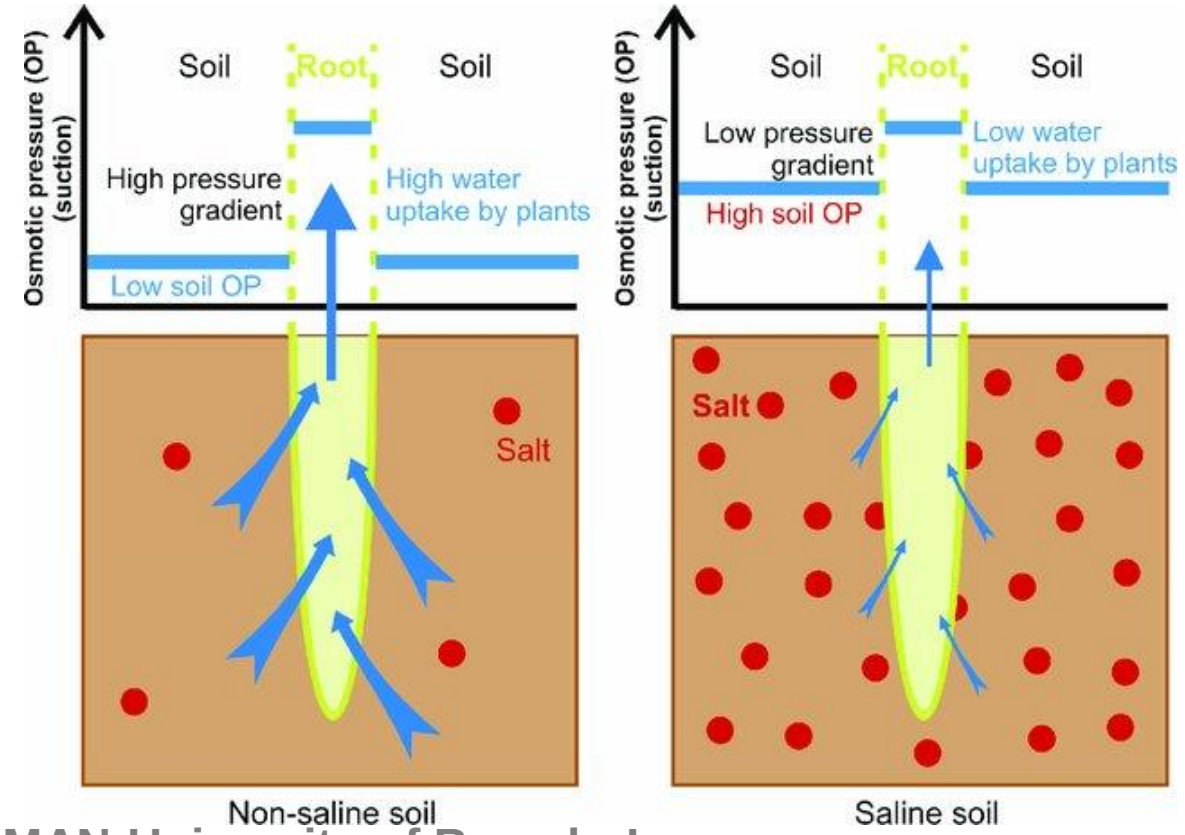
Salinity exerts its detrimental effect on plants by two mechanisms:

❖osmotic stress

The first effect is short term and occurs due to the uptake of Na^+ and Cl^- which reduce osmotic potential between root and soil solution and infiltrate water availability (Abbasi et al., 2016)

$$\Psi = \Psi_s + \Psi_p + \Psi_g + \Psi_m$$

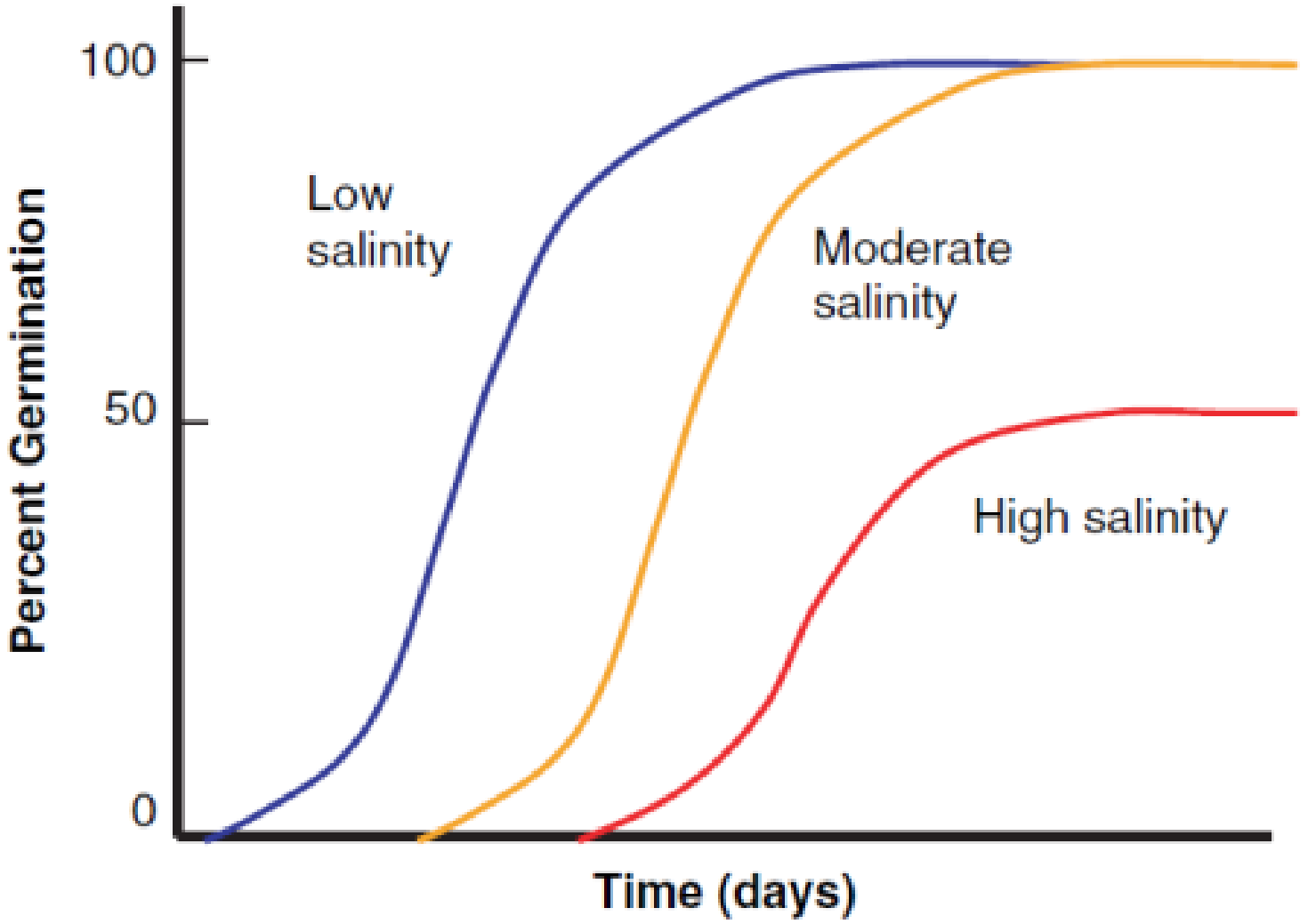
Ψ_s stands for solute potential
Ψ_p : for pressure potential
Ψ_g : for gravitational potential
Ψ_m : for the matric potential



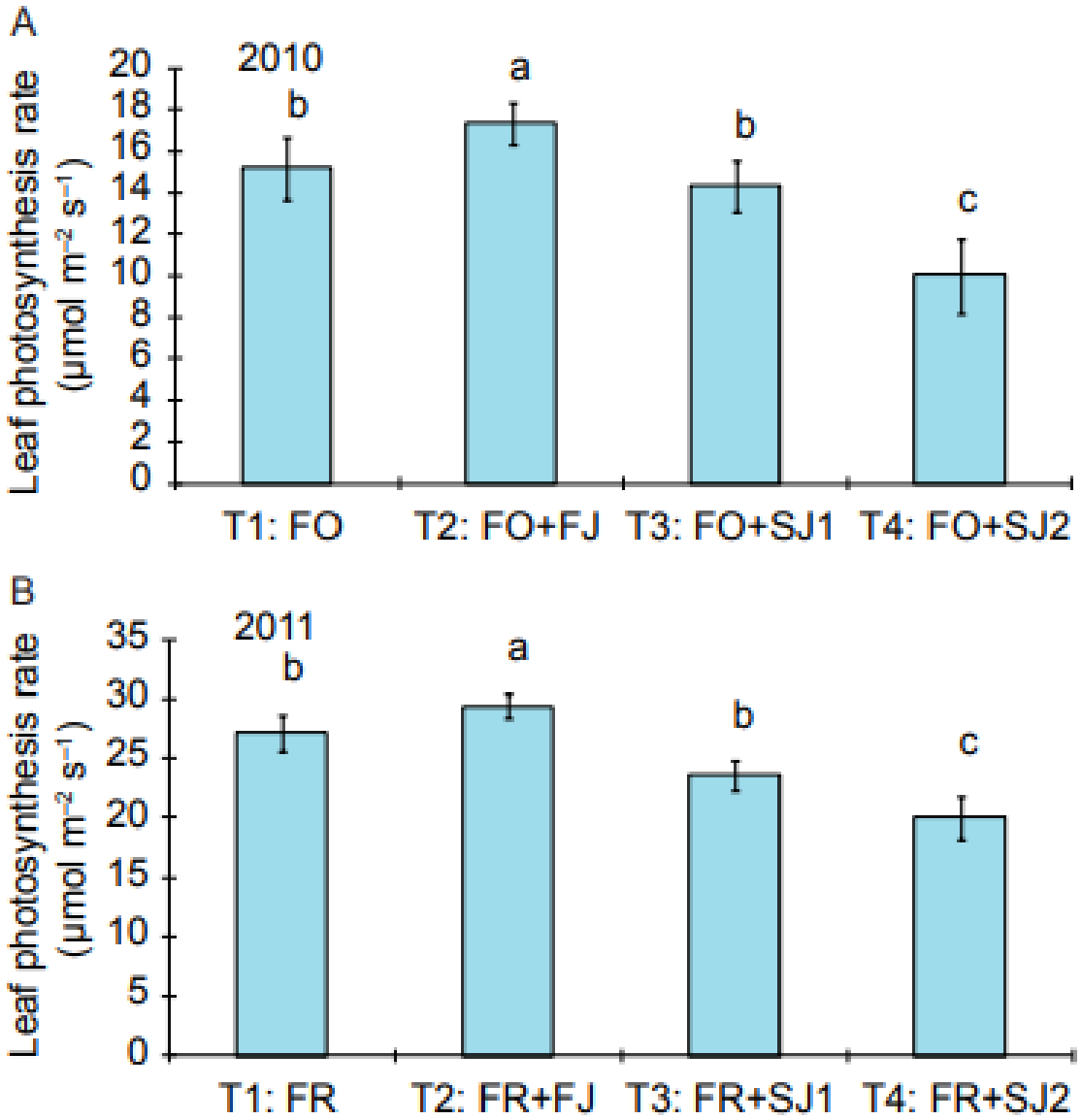
- **High concentrations of Na^+, Cl^-, or SO42- induce ion toxicity that affect nutrient uptake (Tavakkoli et al., 2011)**

- **Also may case nutrient unbalance, affecting plant growth and yield.**

Negative effect of salinity on Germination

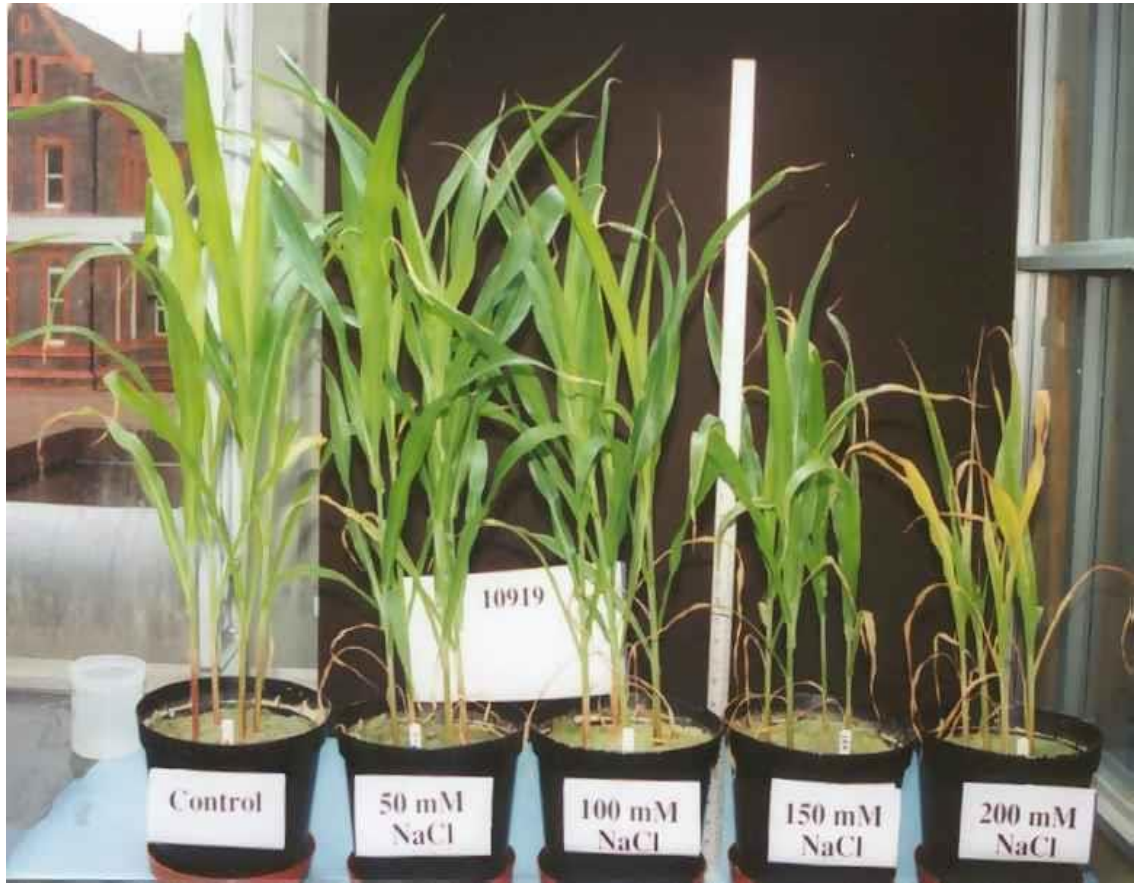


The negative effect of salinity on photosynthesis

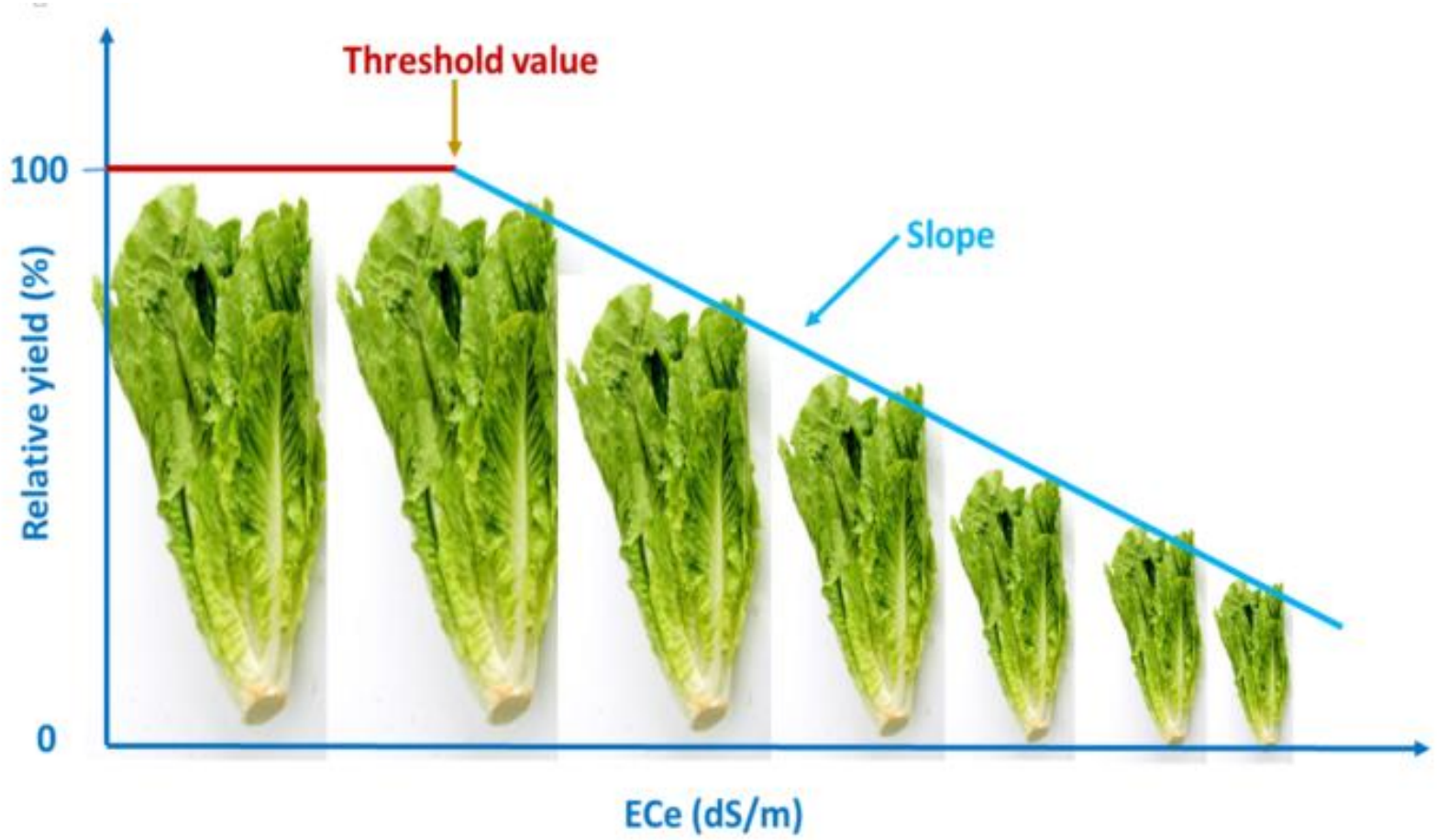


The negative effect of salinity on growth

- The plants will be yellow and weak
- Reduced plant growth
- Reduced leaf area
- Reduced number of spike and spikelet's



The negative effect of salinity on yield



- Threshold: the EC of soil saturated extract (ECe) when yield starts decrease.
- Slope: % of yield decrease when ECe increased by 1 dS/m.
- RY (%) = 100 - Slope * [ECe - ECe (Threshold value)]

Management Practices to Prevent and Mitigate Soil Salinization

1- Chose the crops which have the ability to tolerate salinity

Crop		EC of saturated soil extract	
Common name	Botanical name	50% yield, dS/m	50% emergence, dS/m
Barley	*Hordeum vulgare*	18	16-24
Cotton	*Gossypium hirsutum*	17	15
Sugarbeet	*Beta vulgaris*	15	6-12
Sorghum	*Sorghum bicolor*	15	13
Safflower	*Carthamus tinctorius*	14	12
Wheat	*Triticum aestivum*	13	14-16
Beet, red	*Beta vulgaris*	9.6	13.8
Cowpea	*Vigna unguiculata*	9.1	16
Alfalfa	*Medicago sativa*	8.9	8-13
Tomato	*Lycopersicon lycopersicum*	7.6	7.6
Cabbage	*Brassica oleracea capitata*	7.0	13
Maize	*Zea rnays*	5.9	21-24
Lettuce	*Lactuca sativa*	5.2	11
Onion	*Allium cepa*	4.3	5.6-7.5
Rice	*Oryza sativa*	3.6	18

(After Maas, 1986).

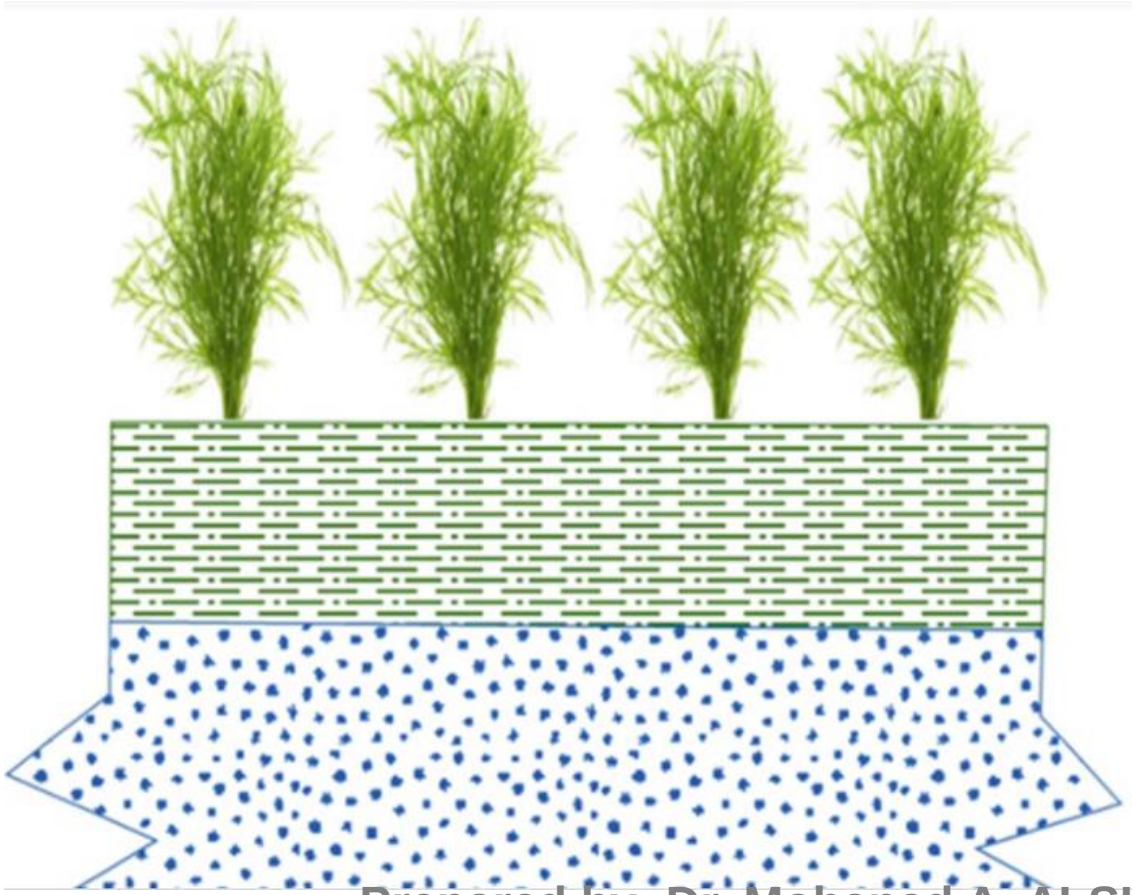
Relative salt tolerance of various crops

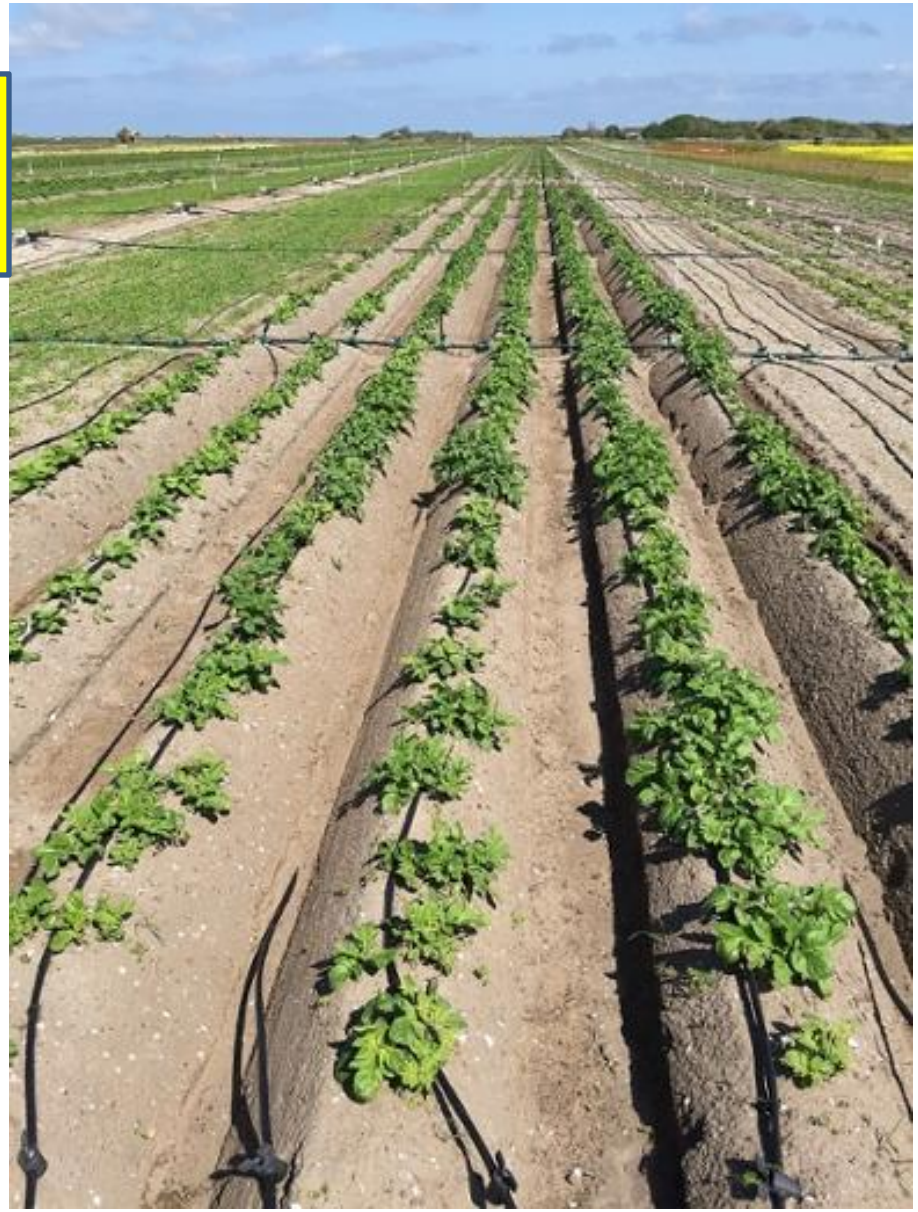
Management Practices to Prevent and Mitigate Soil Salinization

2- Choosing Proper irrigation and agronomic management practices such as leaching, selection of salinity/specific ion tolerant plants, and soil/water amendments… etc can reduce the adverse effect of salinity on crop production.

Management Practices to Prevent and Mitigate Soil Salinization

3- Increased leaching by choosing suitable cultivation system

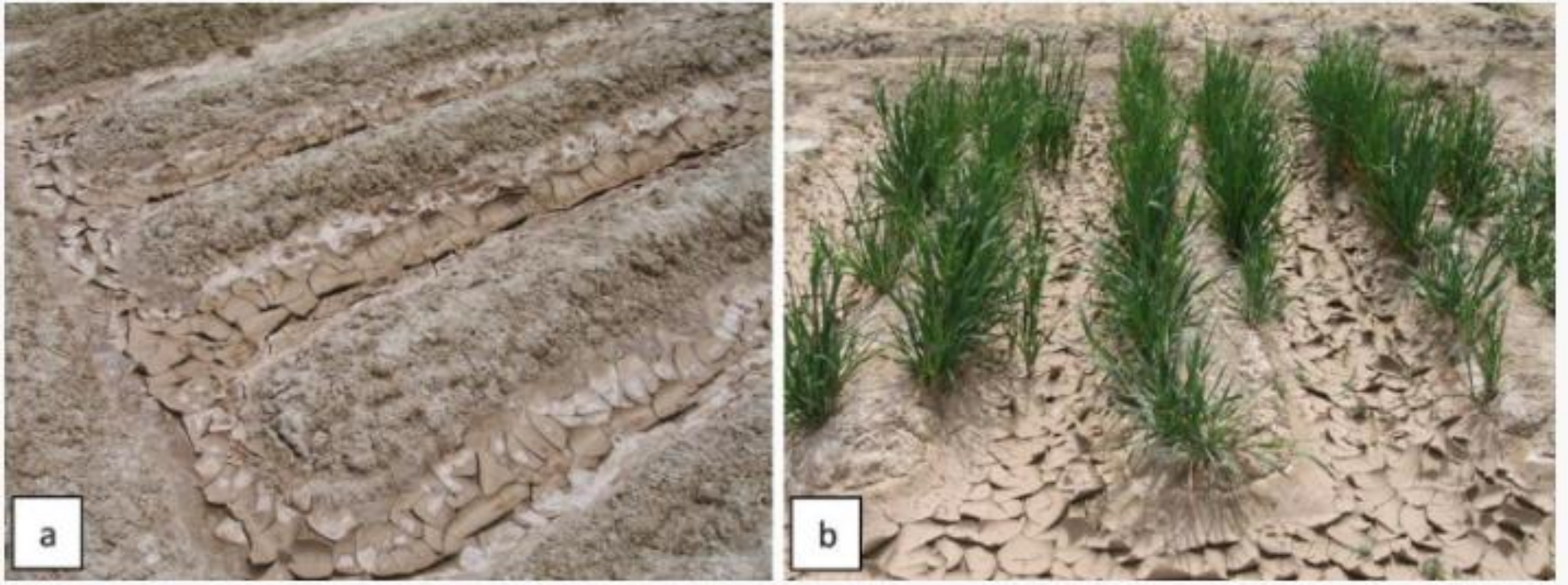




Management Practices to Prevent and Mitigate Soil Salinization

3- Choosing suitable cultivation system

to avoid accumulated salinity

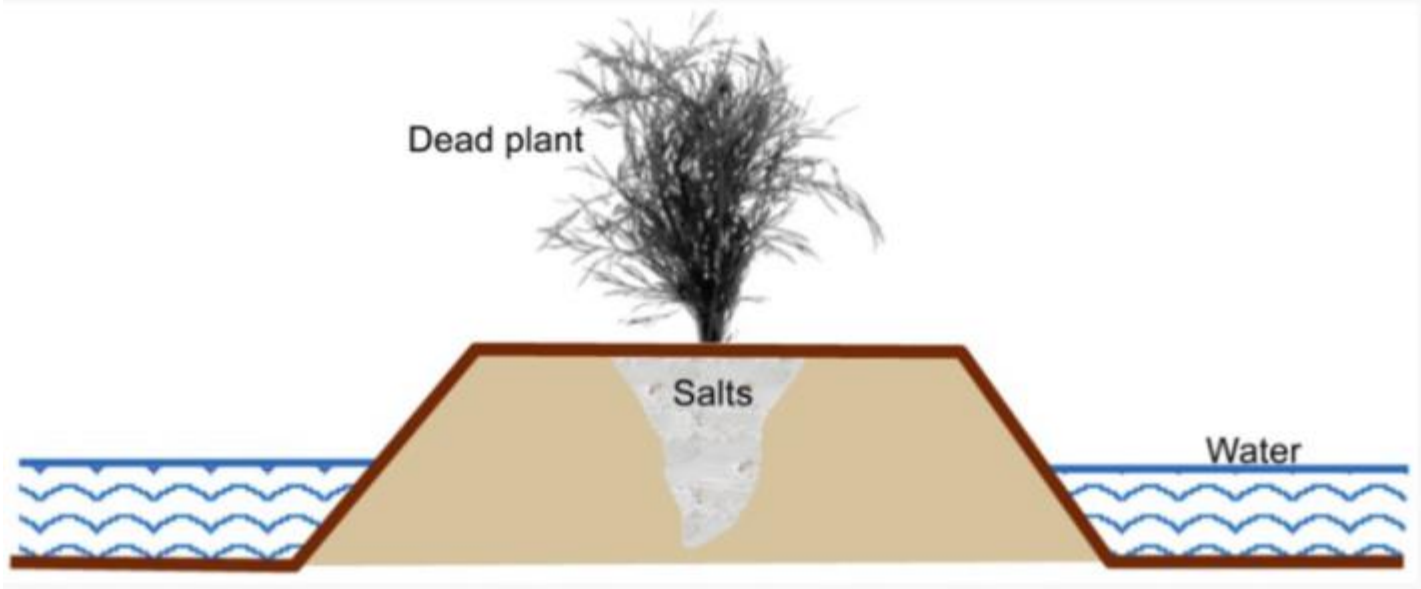


تتم الزراعة على مروز لغرض التخلص من التاثير الملحي وذلك من خلال الزراعة في الثلث العلوي من المرز بعيدا عن مكان تجمع الاملاح

Management Practices to Prevent and Mitigate Soil Salinization

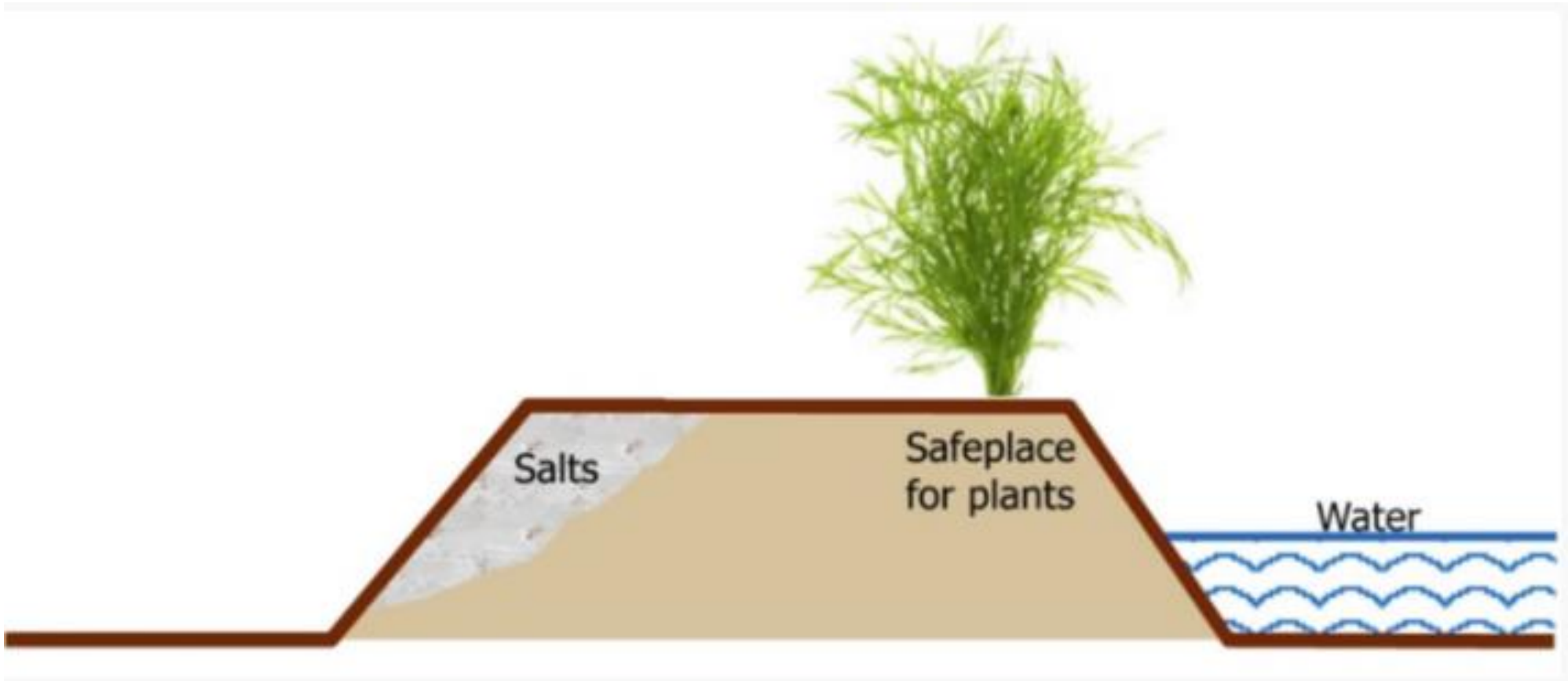
3- Choosing suitable cultivation system

to avoid accumulated salinity



Management Practices to Prevent and Mitigate Soil Salinization

3- Choosing suitable cultivation system to avoid accumulated salinity



Management Practices to Prevent and Mitigate Soil Salinization

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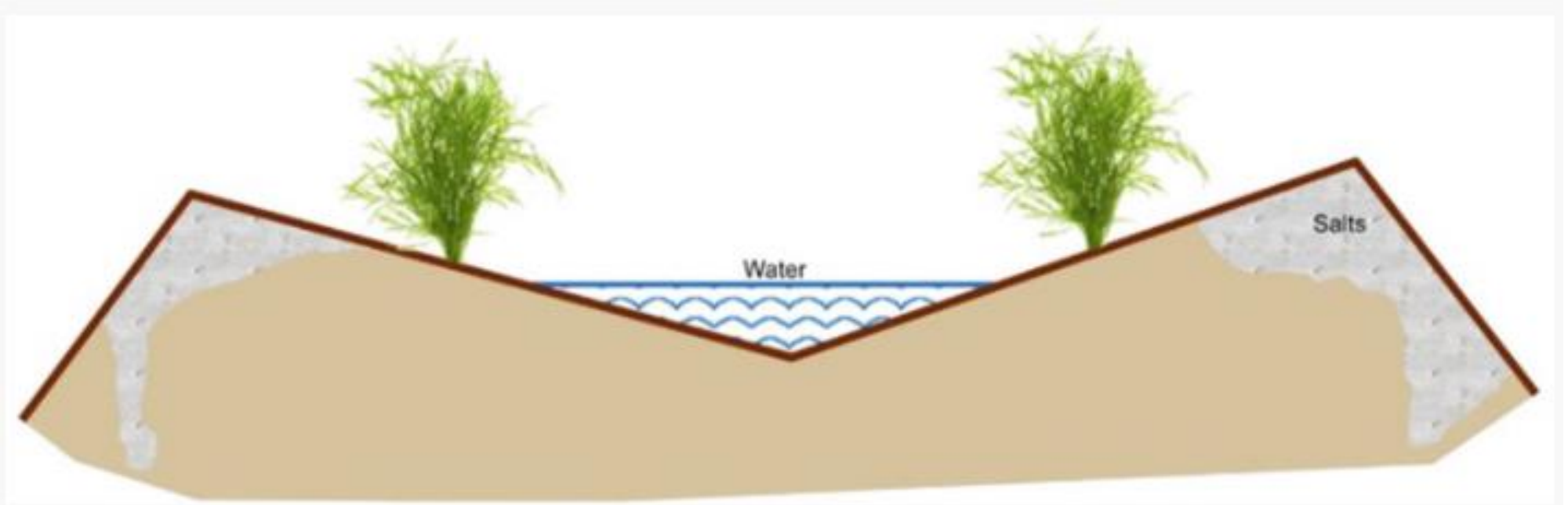
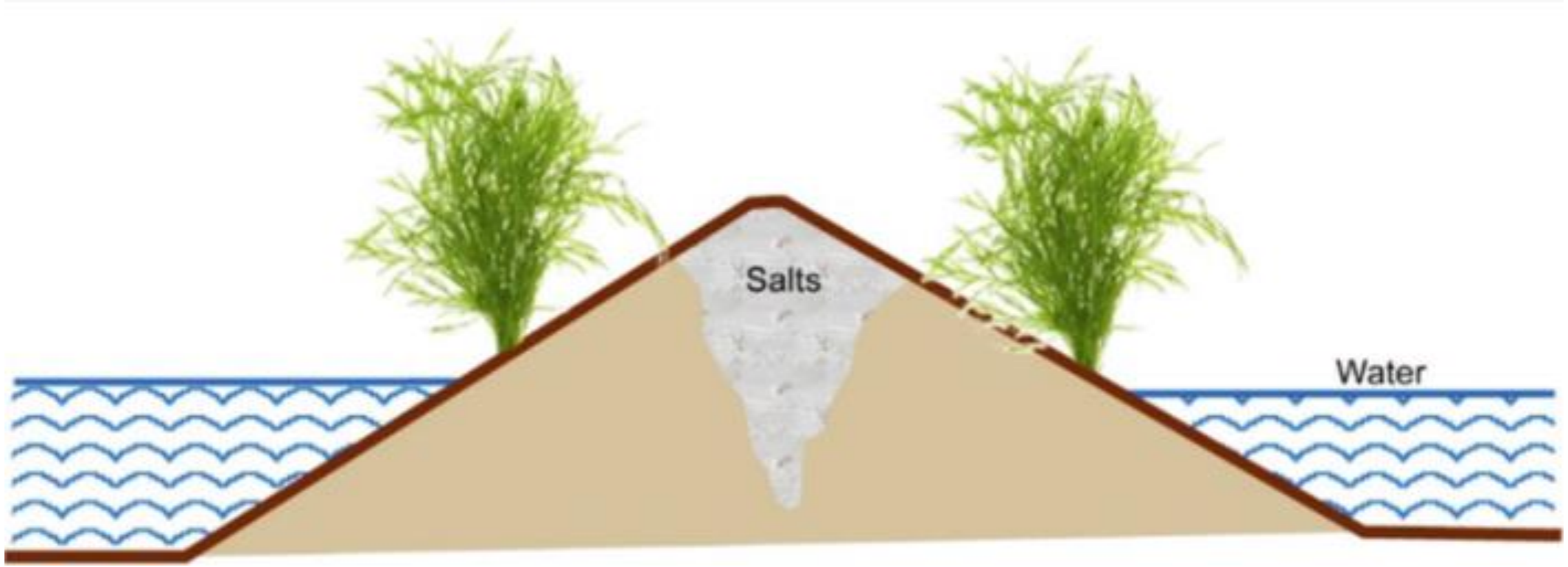


Fig. 4.9
Salt accumulation on sloping beds and the safe zone for seeding

Management Practices to Prevent and Mitigate Soil Salinization

3- Choosing suitable cultivation system to avoid accumulated salinity



Crop management under salt affected soils

4- Optimize water irrigation by: تقنين ماء السقي المستخدم

- reduce salty water usage
- implement drip irrigation
- use desalinated
- Recycled
- Rain-harvested water, and don’t overirrigate).

Management Practices to Prevent and Mitigate Soil Salinization

5- Add organic matter and manure on soil surface after planting, to keep moisture and reduce evaporation and irrigation.

Management Practices to Prevent and Mitigate Soil Salinization

6- Restrain from deep tillage/heavy machinery not to transfer soil salts to the root zone area, which induces salinization.

Management Practices to Prevent and Mitigate Soil Salinization

7- Use cover crops or mulch to protect the ground surface.

Types Of Cover Crops. There are three main categories, depending on their properties and options for use:

- **grasses**
- **legumes**
- **broadleaf non-legumes.**

In most cases, they combine several functions at a time, like preventing erosion, improving soil quality, serving for grazing, among others.

Management Practices to Prevent and Mitigate Soil Salinization

8- Application of gypsum in soil with low concentrations of carbonate has been extensively studied (Horney et al., 2005; Gharaibeh et al., 2011).

It is commonly used to supply Ca^{2+}. However, for soil containing high carbonate content, sulphuric acid is recommended (Horney et al., 2005), which increases soil Ca^{2+} levels by dissolving $CaCO_3$ in soils (Zia et al., 2007; Vance et al., 2008).

The use of inorganic amendments are costly and labor intensive, and is an unhealthy practice for beneficial microbes.

The Conclusion

- **We conclude that the crop cultivation under salt affected soils should be manage in order to maintain soil and get sufficient yield.**

Thank you for your attention