RANKING OF CRITICAL FACTORS IN PLANTS AMELIORATION USING BEST WORST METHOD

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Abstract: - Remarkable changes in the environment have been impacting production ability of the plants. Few variation strategies are available to adapt for the environment changes outcomes as maximum and minimum temperature in the amelioration phase of the plants. A large portion of the plants express affectability to saltiness of the dirt. Considering the tediousness of various kinds, it is needful to perceive the possible obstructions in plant amelioration. However, It has been observed that critical factors in plants amelioration are required to be explored. The prime objective of the current research work is to analyze the critical factors in plants amelioration. Eight critical factors in plants amelioration are identified from literature survey with the help of input of experts. Best Worst Method is chosen to rank critical factors in plants amelioration. Input data has been collected with the help of a group discussion with biologists and agriculture scientists. The results may prove helpful for making the policy to curb critical barriers in plants amelioration.

Keywords: - Plant Amelioration; Critical factors; Best Worst Method

1. INTRODUCTION

Plant growth and amelioration are controlled by climatic conditions and the environment. In other words, plant growth and geographical distribution are greatly influenced by climate and climatic conditions. Directly or indirectly, most plant problems are caused by climate stresses and the most ecologically important climatic factors are plant growth, are affected by light, temperature, water (rainfall), and lack of water [1]. According to the Oregon State University Extension Service, light, water, temperature, and available nutrients are the four things that affect plant growth the most. Growth is a permanent, irreversible increase in the size of an organism. This feature is seen in all plants with many metabolic processes. In plants, the seeds germinate and develop into a new seedling, which eventually develops into an adult plant and exhibit indefinite growth [2]. Plant cells are interconnected by rigid walls, setting their positions in relation to each other, and causing a mechanical reaction between cells [3]. Plant growth and amelioration is accomplished by a number of chemical and physical processes that are controlled by climate factors such as light, water, temperature, oxygen, and carbon dioxide.

When some fluctuations in these climate factors start, then it directly affects the plants amelioration. Temperature is a primary factor affecting the rate of plant amelioration [4]. Plants with prolonged water pressure or inadequate nutrition will be weak and may have abnormal leaves, flowers, or fruits. If an climate stress occurs even for a short period of time at an important stage of amelioration, the plant may never express its full genetic potential. Climate is a major factor controlling the distribution of species because abiotic thresholds determine the abundance and geographic boundaries of species along climate gradients. Plants, in general, have two strategies in the face of stressors: avoidance and resistance. With respect to winter, plants avoid chilling, frost, and desiccation by overwintering as seeds or as belowground corm or regenerative root stock. The most obvious morphological adaptation to resist winter stresses is the deciduous habit of many woody species [5]. Many plants remain active in winter, during which they also take up nutrients. Due to increase in temperature during summer, difficulties also arise in morphological and metabolic activities in plants.

1.1. Plant Growth Stages

When we think about the beginning of a new plant, our attention turns to the seed. A seed is a plant in a dormant state, inside which its life system remains closed. This system also contains the embryo of the plant and a sufficient amount of food material to keep it alive, which crosses its germination and early life. Plant growth is unique because plants retain the capacity for unlimited growth throughout their life. This ability of the plants is due to the presence of meristems at certain locations in their body. The cells of such meristems have the capacity to divide and self-perpetuate. The product, however, soon loses the capacity to divide and such cells make up the plant body. This form of growth wherein new cells are always being added to the plant body by the activity of the meristem is called the open form of growth. Different stages of lant growth have been shown in Figure 1.

1.1.1 Sprout

Each seed contains a tiny stash of nutrients they need to germinate and grow their first pair of leaves. Basically, it is the phase of the plant's growth cycle that is responsible for plant reproduction.

1.1.2 Seeding

As plant roots develop and spread, rapidly absorbed, well-balanced nutrients promote rapid growth from spindly seedling to healthy plant. The seedling stage is where the plant grows from seed. In the right environment, seeds begin to produce familiar parts, including roots, stems, and leaves

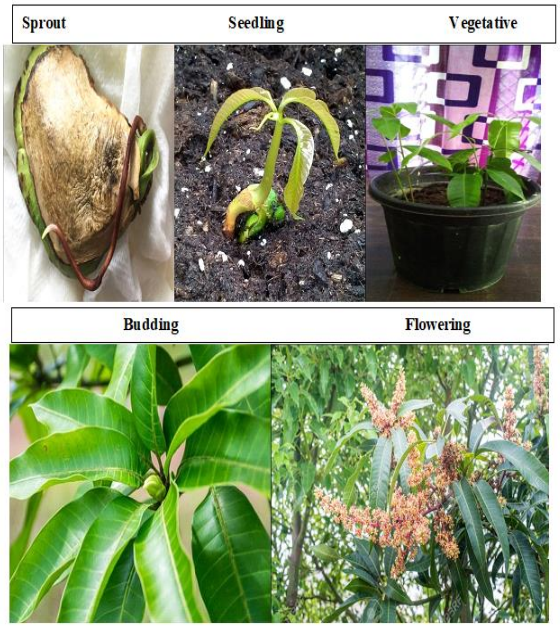


Figure 1. Different growth stages of plant

1.1.3 Vegetative
Nitrogen is a major component of chlorophyll, the green pigment in plants, so it is an important nutrient when focusing their energy on growing stalks and foliage. The vegetative stage is when the plant germinates and produces its first green tendencies. This happens about 5-60 days after you sow your seeds. It will all depend on the type and type of plant you are trying to grow. As a rule, the larger the plant you are trying to grow, the longer it takes to reach the vegetative stage. During this stage, the plant matures, produces more leaves and becomes taller, larger and healthier.

1.1.4 Budding
There is an extra high demand for phosphorus at the beginning of a plant's reproductive cycle, the transition from growing leaves to buds.

1.1.5 Flowering
Potassium plays a primary role in the production and transport of sugars and starches plants use as they develop healthy flowers and fruits. The flowering stage is the time when your plants prepare themselves to produce fruit or show some flowers.

Paper is settled as the critical reviewing of past work has been done in Section 2. Method applied in the presented work has been explained in Section 3.The factors in plants amelioration have been recognized and presented in Section 4. Assessment of data and results are shown in Section 5. In the last section, Concluding statements are communicated with possibilities for future.

2. REVIEW OF RELEVANT LITERATURE

Temperature is a primary factor affecting the rate of plant amelioration. Warmer temperatures expected with climate change and the potential for more extreme temperature events will impact plant productivity. Normal temperatures increased the rate of phonological amelioration; however, there was no effect on leaf area or vegetative biomass. The major impact of warmer temperatures was during the reproductive stage of amelioration and in all cases grain yield in maize was significantly reduced by as much as 8090% from a normal temperature regime. Temperature effects are increased by water deficits and excess soil water demonstrating that understanding the interaction of temperature and water will be needed to develop more effective adaptation strategies to offset the impacts of greater temperature extreme events associated with a changing climate [4]. Plants are sessile and photo-autotrophic; their entire life cycle is thus strongly influenced by the ever-changing light environment. the effects of different supplemental light qualities on growth of ‘Red Cross’ baby leaf lettuce (Lactuca sativa L.) grown at a high planting density under white fluorescent lamps as the main light source inside a growth chamber. They reported 25 °C/20 °C in all treatments including white light control. After 12 days of light quality treatment (22 days after germination) growth of lettuce plants were significant affected by light treatments. Anthocyanins concentration increased by 11% and 31% with supplemental UV-A and B, respectively, carotenoids concentration increased by 12% with supplemental B, phenolics concentration increased by 6% with supplemental R while supplemental FR decreased anthocyanins, carotenoids and chlorophyll concentration by 40%, 11% and 14%, respectively, compared to those in the white light control [6]. Agricultural crops exhibit a spectrum of responses under salt stress. Salinity not only decreases the agricultural production of most crops, but also, effects soil physicochemical properties, and ecological balance of the area. The impacts of salinity include—low agricultural productivity, low economic returns and soil erosions. For all important crops, average yields are only a fraction – somewhere between 20% and 50% of record yields; these losses are mostly due to drought and high soil salinity, climate conditions which will worsen in many regions because of global climate change [7]. From literature review, it is clear that analysis of critical factors in plants amelioration is a complex task to be addressed. Therefore, it becomes essential to identify critical factors in plants amelioration. Next section deals with identification of critical factors in plants amelioration.

3. METHODOLOGY

In the present work a newly developed MCDM method by Rezaei, best worst method, has been utilized [9]. It’s method is based on two evaluation vectors, The Best criterion against the Other criteria, the Other criteria against the Worst criterion. The weights of the criteria are determined by solving a linear [10] or a nonlinear model. The ability of BWM to obtain more consistent results due to its structured pair wise comparison system makes it much employable [11].

Compared to the popular pair wise comparison based MCDM method AHP, it allows to determine several reliable results according to previous analyses[9]. The Best-Worst Method utilises ratios of the relative importance of criteria in pairs on the basis of the analysis performed by decision-makers[12]. The BWM incorporates determining a solution of a nonlinear model to derive the weights from the comparisons. A linear model had been developed in a follow-up to approximate the initial nonlinear model [13].

There are three effective methods to get the quantum of importance of the attributes within the Best-Worst scaling. These may be the object case, the profile case, the multi-profile case. In object case, the respondent is said to pick the best and worst alternatives out of a series of objects, without showing any characteristic. In the profile case, the respondent is said to select the best and worst from a list of attributes, the selection is made between the different characteristics. Third case is related to the classic discrete alternative experiments, while the alternatives are made between a group of alternatives consisting of different characteristics with different levels[14]. The steps of the BWM have been shown in Figure 2.

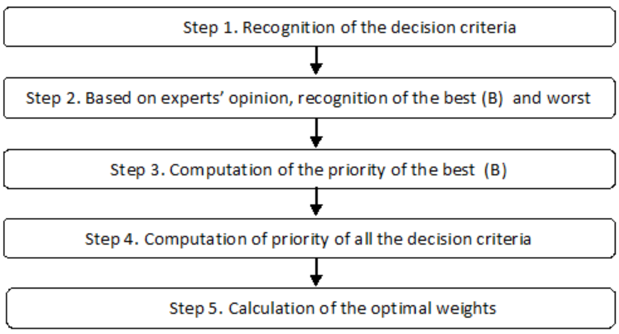


Figure 2 - Steps in Best Worst Method

4. IDENTIFICATION OF CRITICAL FACTORS IN PLANTS AMELIORATION

To obtain the main objective of our research work that is the exploration of critical factors in plants amelioration, various research papers published were reviewed. There are several factors which affect the plants amelioration directly or indirectly. The figure 2 displays the overall scheme corresponding to complete hierarchical structure of factors taken in the current research work. Eight critical factors in plants amelioration have been sorted from the contributed research and expert's inputs as 'Light', 'Temperature', 'Water', 'Drought', 'Soil'; 'Pollution', 'Fertilizers', 'Deforestation' as tabulated in Table 1.

Table 1. The proposed critical factors in plants amelioration

Critical factors in plants amelioration	**Abbreviation**
Light	LT
Temperature	TP
Water	WT
Drought	DT
Soil	SL
Pollution	PL
Fertilizers	FT
Deforestation	DF

4.1 Light

Light is necessary for photosynthesis, the process that converts light energy into chemical energy. All green plants require light for growth to take place. Some plants (most species) prefer growing in direct sunlight, while others prefer growing in the shade where they are subjected to indirect sunlight. Plants grown under protection such as greenhouses and shade houses require adequate light for the process of photosynthesis. Photo processes in the plant vary in the intensity of the light required to initiate the reactions and the effect of the intensity on the rate of the reaction. The rate of photosynthesis drops on cloudy days.

4.2 Temperature

In propagation chambers, the temperature can often be maintained at this ideal level by heating and cooling systems. The heat is also used for increasing the humidity in the chambers, by drenching the trays and dampening the floor. Maintaining day/night temperatures at specific levels can increase yield and quality of crops. Optimum growth of many crops occurs when greenhouse temperatures are cooler at night than during the day. The response of plants to diurnal temperature fluctuations is referred to as thermo periodicity. High temperatures limit biological reactions because the complex structures of proteins are disrupted or denatured.

4.3 Water

Water deficiency conditions during May, June, and July are not frequent. These months constitute the primary period of production for range plant communities. August, September, and October experience water deficiency conditions more than half the time and are not dependable for positive water relations. Water and precipitation act together to affect the physiological and ecological status of range plants. The balance between rainfall and potential evapotranspiration determines a plant's biological water potential status. Precipitation evapotranspiration levels interact and influence the rates of the carbon and nitrogen cycles. Plants in water stress have limited growth and reduced photosynthetic activity.

4.4 Drought
In agricultural ecosystems, drought has a detrimental effect on crop production, affecting the growth rate and amelioration of the economically important portions of the plant, such as fruits, grains and leaves. Drought stress in plants is characterized by reduced leaf water potential and turgor pressure, stomatal closure, and decreased cell growth and enlargement. Drought stress reduces the plant growth by influencing various physiological as well as biochemical functions such as photosynthesis, chlorophyll synthesis, nutrient metabolism, ion uptake and translocation, respiration, and carbohydrates metabolism.

4.5 Soil
The physical and chemical properties of the soil are referred to as edaphic factors of the plant environment. The physical properties include the soil texture, soil structure, and bulk density which affect the capacity of the soil to retain and supply water, while the chemical properties consist of the soil pH and Cation Exchange Capacity (CEC) which determines its capacity to supply nutrients. Soil structure affects plant growth in many, often surprising, ways.

4.6 Pollution
Air pollutants cause damage to leaf cuticles and affect stomatal conductance. They can also have direct effects on photosynthetic systems, leaf longevity, and patterns of carbon allocation within plants. Polluted water in the ground actually washes the essential nutrients plants need out of the soil. Without these nutrients, plants become more susceptible to drought, fungal infections and insects. Water pollution also leaves large amounts of aluminum in the soil, which can be harmful to plants.

4.7 Fertilizers
Fertilizers are not plant food! Plants produce their own food from water, carbon dioxide, and solar energy through photosynthesis. This food (sugars and carbohydrates) is combined with plant nutrients to produce proteins, enzymes, vitamins, and other elements essential to growth. The more fertilizer a crop receives, the faster it grows. We know if a crop is provided with too little fertilizer, plant growth response is poor; but if fertilizer rates are excessive, plant growth slows and there is a potential for root damage or death from high fertilizer salts.

4.8 Deforestation
Deforestation can directly lead to biodiversity loss when animal species that live in the trees no longer have their habitat, cannot relocate, and therefore become extinct. Deforestation can lead certain tree species to permanently disappear, which affects biodiversity of plant species in an environment.

5. RESULTS

For validation of our proposed model, a group discussion with biologists and agriculture scientists was performed. Following is the formation of the priority of the best criteria over the others on a 9-point scale as shown in table 2

Table 2- Priority of the best criterion (B) over all the other criteria

The best	LT	TP	WT	DT	SL	PL	FT	DF
WT	2	5	1	7	3	9	6	5

Following is the formation of the priority of all the decision criteria over the worst criterion (W) on a 9-point scale as shown in table 3

Table 3- priority of all the decision criteria over the worst criterion (W)

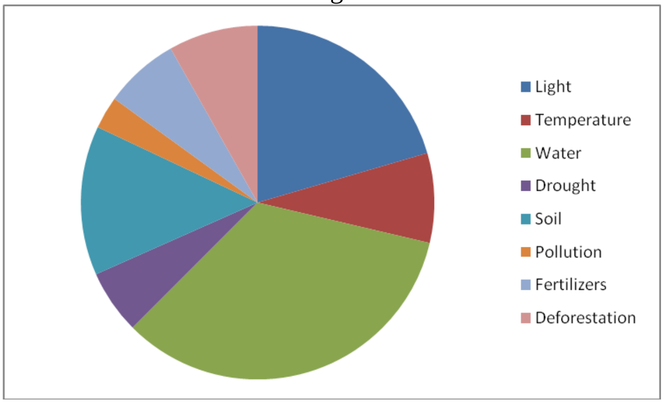
The Worst	PL
LT	8
TP	5
WT	9
DT	3
SL	7
PL	1
FT	4
DF	5

Final values of the optimal weights have been calculated and tabulated in Table 4.

Table 4- Weights of all the barriers in social distancing

ξ	0.0712
Relative Weight of Light	0.2048
Relative Weight of Temperature	0.0819
Relative Weight of Water	0.3384
Relative Weight of Drought	0.0585
Relative Weight of Soil	0.1365
Relative Weight of Pollution	0.0297
Relative Weight of Fertilizers	0.0683
Relative Weight of Deforestation	0.0819

Table 4 depicts the priorities calculated using the Best Worst Method and the ranking of the various issues.



It has been found that 'Water' is the most important factor in plant amelioration, followed by 'Light' and 'Soil'.

6. CONCLUSIONS AND SCOPE FOR FUTURE WORK

This work has projected a multi-criteria decision making (MCDM) methodology for analysis of critical factors in plants amelioration using Best Worst Method, considering eight factors ('Light', 'Temperature', 'Stresses'; 'Water', 'Drought', 'Soil'; 'Pollution', 'Fertilizers', 'Deforestation'). Total eight critical factors in plants amelioration have been compared and ranked. The current work has explored the possible aspects which can become key to address the critical factors in plants amelioration. It is clearly evident from the findings of the present work that 'Water' has emerged the most critical factor in plants amelioration followed by 'Light' and 'Soil'.

Some other multi-criteria decision making techniques like TOPSIS, ANP, DEAMATEL methodology with some appropriate statistical tool like Structural equation modeling technique may be utilized for similar problems and their results may be further compared.

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