ELECTROPHYSIOLOGICAL DETERMINATION OF OPTIMAL CONCENTRATIONS OF NITROGEN, POTASSIUM AND PHOSPHORUS (NPK) FOR THE GROWTH OF SELECTED CROP PLANTS

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The composition and quantitative values of nutrients in soils of northern India, where wheat is a major crop is not well evaluated and documented. The amount of different fertilizers used in agriculture is on ad hoc basis. This entails a lot of loss of money spent on purchase and use of the different fertilizers used in agronomic practice. Plants require macro and micronutrients, which are appropriate for growth and replication. It is of crucial importance in agronomic practice to determine the optimal conditions for the growth of plant.

It becomes imperative for the scientists to provide with the requisite information regarding the composition of the soil and the amount of minerals to be added for the best yield that can be produced. An efficient scientific procedure should be available that can guide the farmers to obtain maximal agricultural produce with an optimal amount of artificial manure. It follows from the above that there cannot be one methodology, which can determine the set of nutrients adequate for the whole life span of the plant. Our objective has been only to concentrate on the early growth of the plant.

Membrane potential (E_M) of mesophyll cells of wheat seedlings, grown in IX-nutrient solution under different concentrations of N, P and K, and PEG induced water stress condition were measured. In addition to the electrophysiological determination of $E_{M,}$ conventional parameters of growth such as length, fresh weight and dry weight of shoot and roots were also studied in order to determine the adequate dose of nutrients for optimal growth and productivity. We have taken three essential elements: nitrogen, phosphorus and potassium (NPK) and varied the concentrations of these macronutrients in the IX-nutrient medium (Hoagland et al., 1970). These are considered to be the macronutrients for the vegetative growth of a plant. We selected four varieties of wheat: C-306, HD-2329, PBW-343, HD-2643 in our study and used a highly sensitive electrophysiological technique to determine the intrinsic energy status of the plant in terms of membrane potential (E_M) at the seedling stage.

In all the varieties studied, the value of E_M was found to be hyperpolarized, when NPK

concentrations were increased and there was a depolarization in E_M when the concentrations of these nutrients were reduced in the control media.

Our study revealed that the wheat variety, C-306 had lowest negative E_M value, compared to three other varieties; HD-2643, HD-2329 and PBW-343. The concentrations of macronutrients (NPK) in IX-medium had significant influence on E_M values of both resistant and susceptible varieties. However, the degree of influence of NPK concentrations seems to vary for different varieties. An increase in K^+ concentration in IX medium up to an optimal level could be helpful to growing seedlings. Both Phosphorus & Nitrogen showed a significant increase or decrease in E_M, although varietal differences were observed. With decreasing concentrations of NPK in the medium, the E_M decreased in all the varieties.

On imposition of PEG induced water stress, the E_M of a resistant variety, C-306 hyperpolarized while the negativity is reduced in case of susceptible varieties, PBW-343, HD3643 and HD-2329. Addition of 9mM KCl in PEG reduced the E_M value in all the varieties. Systematic correlation exists between varietal drought tolerance and E_M variation under PEG induced water stress.

In order to corroborate our electrophysiological findings we also carried out the conventional methodology of measuring length, fresh weight and dry weight of shoot and root. Length and fresh weight of seedlings increased in most of the cases when the concentrations of N, P or K were increased in the medium. Similarly, no significant changes were observed in dry weight of seedlings with increased/decreased N, P or K in the medium.

No significant effects of NPK (increase/ decrease) were observed on growth parameters of roots in most of the cases. The additional NPK requirements of different varieties for optimal cellular growth seem to be different, which appeared to be well correlated with E_M studies.

Our study suggested that the E_M could be a reliable method to assess the different cultivars for their resistance or susceptibility and state of health & their macro nutrient requirements. The usual practices of field trials are expensive and time consuming. This electrophysiologial technique of measuring E_M is convenient, reliable and requires less input, which could be used for other crop plants as well.

Though the objective of this particular work was confined to a narrow area of research but the approach adopted by us in our opinion is applicable to a large number of plant varieties. Although, the technique adopted by us is restricted to seedlings; however, modifications of the same technique may be designed and executed on full-grown plant in the field also. We hope that agronomic experts would appreciate our humble effort and would pursue this work on a large scale.