

Original Research Article

Principal Component Analysis towards viability of *Cicer arietinum* seeds using electric field under laboratory condition

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Abstract: The impact of power lines on the crops are well established from different observations over the globe. In this work we have carried out an experiment in laboratory to observe the influence of electric field on *Cicer arietinum* seeds. The seeds are exposed to electric field ranges 5 - 25 volt for an interval of 20 minutes. It is noted that the germination percentage is decreased for the exposure time of 120 minutes irrespective of electric field. Treated dose of 10 volt/60 minute is found to be optimum from Principal Component Analysis of the physiological and biochemical characteristics of *Cicer arietinum* seeds.

Keywords: *Cicer arietinum*, germination, electric field, Principal Component Analysis

INTRODUCTION

The germinating capacity depends mainly on the seed viability which may subject to irreversible degenerative changes with time and causes poor yields. Various methods are applied to stimulate germination process. Physical stimulation agents *viz* electric field, magnetic field and ionizing radiations are used to improve the quality of various vegetables, crops and cereals [1-6]. Now concern is raised about the growth of productivity of plants which are environmentally safe. Enhancements of germination of different species with magnetic or electric field are reported by several scientists over the globe [7-12]. There is a scope to investigate the dependence of germination characteristic under electric field on the most widely used *Cicer arietinum* (gram) seeds. The objective of our study is to observe the physiological and biochemical properties of gram seeds under different exposure levels of electric field (EF).

EXPERIMENTAL SETUP

The *Cicer arietinum* seeds (Mahamaya 2 variety) are obtained from Beharampur pulses and oil seed research station, Murshidabad, West Bengal and kept in a dry place. Undamaged seeds are selected manually and five groups of 20 seeds are taken. Seeds are disinfected with HgCl₂ and distilled water and then soaked for 12 hrs in water. The seeds are treated with

electric field strengths 5 to 25 volt (increasing at a step of 5volt) and each field with exposure time from 20 - 120 minute at a step of 20 minutes. The experimental set up is given in Fig 1. The size of the plate and distance between the plates of the electric field are (45Cm/26.5Cm) and 12.5Cm respectively.

METHODOLOGY

Average germination percentage is estimated using the following equation [13].

$$G_p = \sum \frac{N_i}{D_i} \times 100 \quad \dots\dots\dots (1)$$

Where N_i = total number of germinated seeds on the ith day and D_i = Number of seeds used.

Germinated seeds are counted every day and germination ability is considered by the cumulative percentage of germination at the end of 7th day. Samples of germinated seeds are given in Fig 2.

Biochemical parameters *viz* carbohydrate, protein, alpha amylase, catalase and peroxidase content of 7th day seedlings are estimated using standard methods [14-16]. Principal component analysis is computed to observe the contribution of different factors with XLSTAT software win.112 version [17].



Fig-1: Experimental set up



Fig-2: The germinated seeds of *Cicer arietinum* (a) Control (b) Treated (10V/40min)

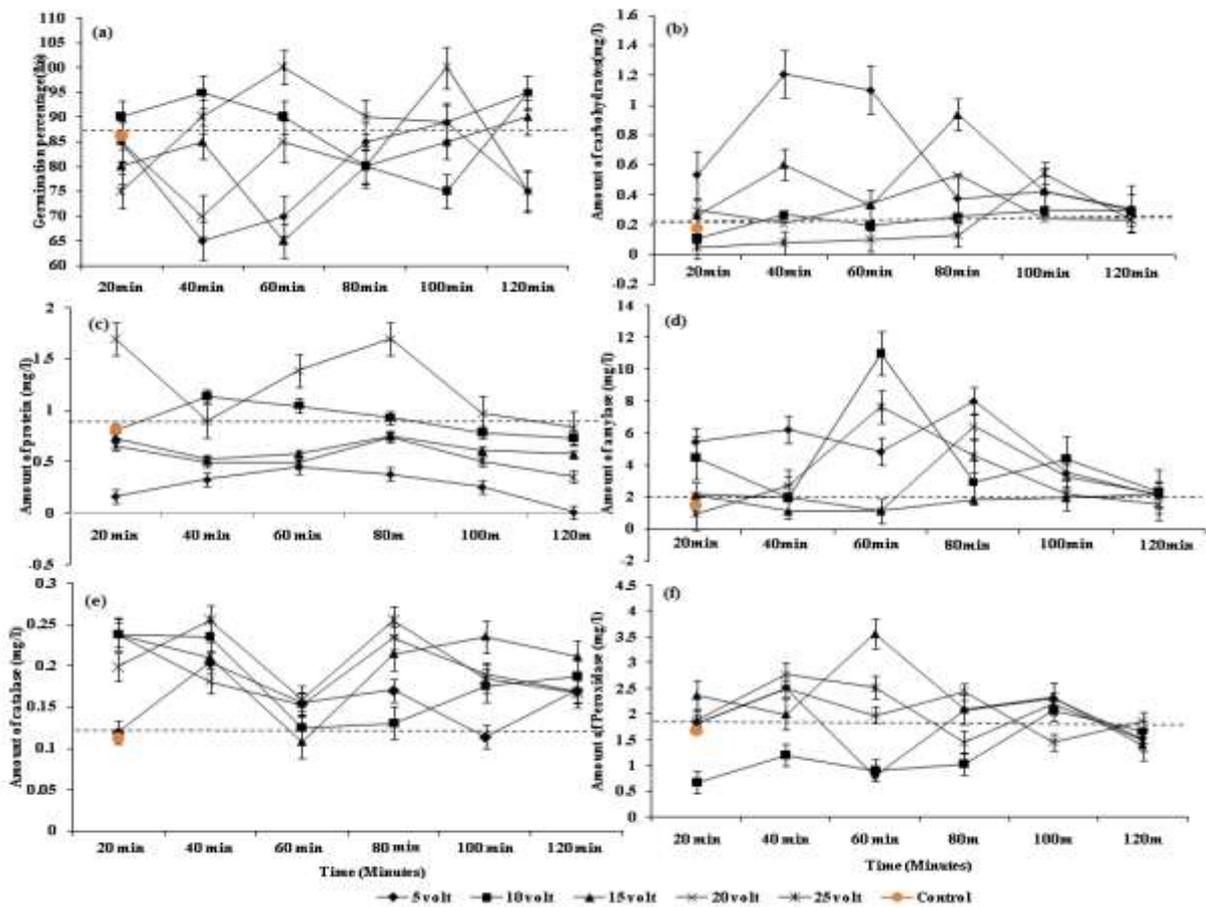


Fig-3: Physiological and biochemical characters of *Cicer* seeds (a) Germination percentage (b) Carbohydrate (c) Protein (d) α amylase (e) Catalase and (f) Peroxidase

RESULTS AND DISCUSSION

Physiological and biochemical characteristics of *Cicer arietinum* seeds under different levels of electric field and exposure time are depicted in Fig 3. The dotted lines are for control seeds. The percentage of germination is found to increase for 10 volt with exposure times 20min, 40min and 60min. Positive response is obtained only for exposure time 100 min for

the applied field of 20 volt. The enhancement of germination is also observed for 40min, 60min and 80 min exposure times at 25volt. Negative responses are obtained for other doses. The increasing level of carbohydrate for all the exposure times is noticeable for applied field 5-20 volts except 20min exposure time at 20 volt.

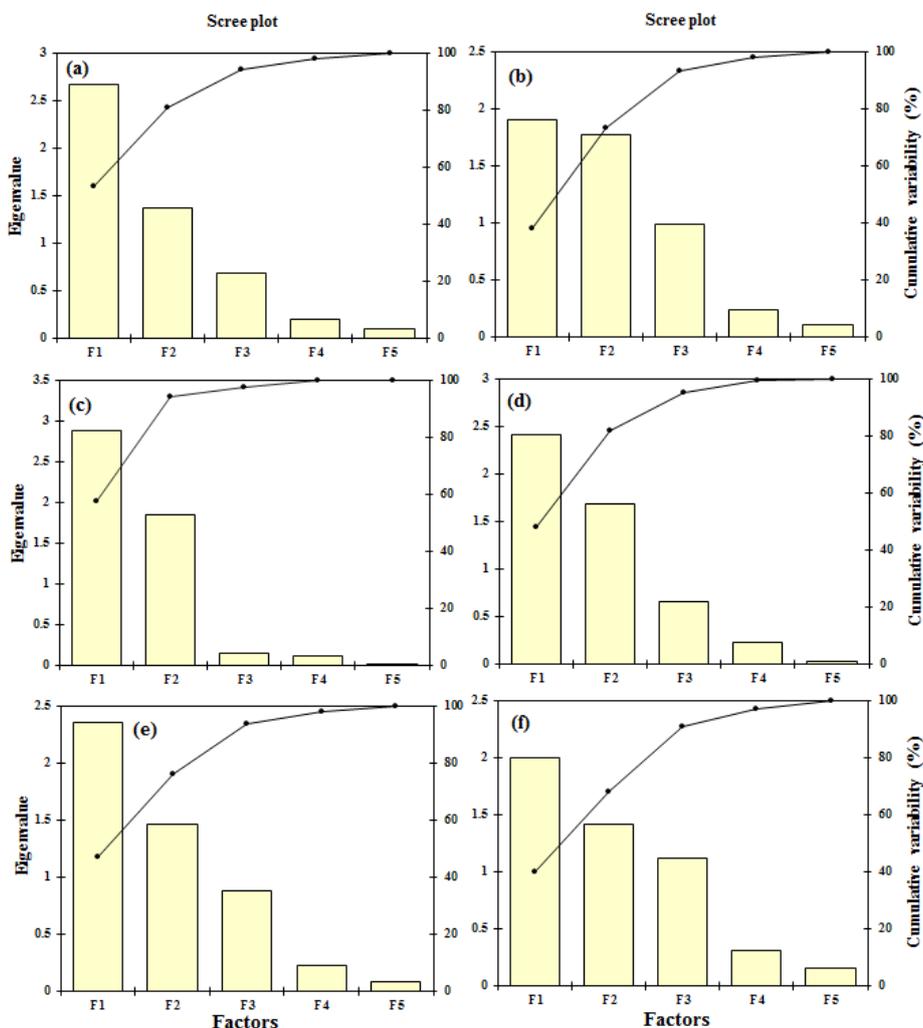


Fig-4: Scree plots of (a) Germination (b) Carbohydrate (c) Protein (d) α amylase (e) Catalase and (f) Peroxidase concentration of *Cicer arietinum*

The carbohydrate content is increased by a factor ranges from 1.18 to 5.86 in comparison with the control. In case of protein positive response are obtained for the levels 10 volt with 20 min, 40 min, 60 min, 80 min and 20 volt with all exposure times.

In case of amylase activity the response is significant for all levels except 25 volt with 20min exposure time. Catalase are found low for the levels of (10 volt, 60 min) and (25 volt,80 min) whereas for peroxidase (10 volt, 60 min), (5volt, 20 min) and (15 volt, 60min) respectively.

Scree plot of the visual explanation of the variability of different treatment using principal component analysis (PCA) is shown in Fig. 4.

CONCLUSION

Electric field has significant effects on seed germination and physical and biochemical properties of young plants. Considering the response of EF on physiological and biochemical characteristics of *Cicer arietinum* seeds, exposure level at 10volt with 60 min exposure may be considered as the optimum for electric field stimulation

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