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Original article

The morphological, anatomical and physiological aspects of maize plant after applying the different level of temperature treatments on pre-sowing maize seeds.

Zobia Anwer^{a*}, Sidra Shabbir^b

P.G and Research Department of Botany, Bishop Heber College, Tiruchirappalli-620017, Tamil Nadu, India

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ABSTRACT

Research was conducted to study the morphological, physiological and anatomical aspects after different level of temperature treatments on pre-sowing maize seeds. Sample seeds were treated with 4 different levels of temperature stress viz. 0°C (T1), 6°C (T2), 35°C (T3) and 60°C (T4) respectively for 24 hrs. Experiment was performed in CBD with triplicates and sow at 35°C soil temperature. The germination percentage of vernalized seeds did not affect at 35°C because seeds were vernalized before sowing. The morphological characters like seedling length (root+shoot), No. of leaves, length of flag leaves, leaf area, fresh weight, dry weight, moisture content, yield, cob length and physiological parameters like chlorophyll content (a, b and carotene) and 17 selected parameters of anatomy under 3 magnification of microscope (4x, 10x, 40x) were studied after staining. Chlorophyll content studied with 2 extraction methods (i) 80% acetone (ii) Distilled H₂O. Leaf extract centrifuge at 3000rpm for 10mins and studied with the help of AAS at different wavelength (chl a, 645nm; chl b, 663nm; carotene, 652nm). The chilling temperature treatment (0°C) of seeds extremely damages the plants due to crystal formation. At 60°C plants were largely affected because 66% moisture content of seeds decreased due to heat shock. Seeds which treated with both high and chilling temperature were shown the thin stem, root, low amount of chlorophyll content, lowest value of morphological parameters and narrow leaf after emergence but vernalized seeds were shown the antagonistic characters as compared to heat shock plants. The maize at 6°C had shown the fast emergence process and highest germination percentage.

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Introduction

Zea mays L. is a versatile plant and belongs to poaceae family. Maize first time grown by native people in Mexico. It is an angiospermic plant and seeds linked with cob structure. The flowers of both male and female inflorescence present on the same plant and plant height is 3m-12m [8]. It's root are primary and endogenously [6]. The optimum or normal temperature for maize growth is 10°C-30°C [10]. The period between emergence and seed sowing is shortening due to low temperature treatment [1] and this treatment provides the ability to plants for fighting against diseases [9]. The chilling injury is the result of extremely low temperature due to crystal formation in cells [14].

The maize seeds treated at 0°C for 1-4 days before sowing and then transferred to 35°C, but the germination % of this seeds is higher than those seeds which directly transferred to 35°C [11]. The absorption of solar radiation rise up the soil temperature up to 50°C [4]. The trichome frequencies increases and size of cell is reduces at high temperature [2]. The endosperm of maize seed is destroyed at high temperature due to disturbance in starch metabolism and cell division [12]. The variation in temperature is

a big issue in Pakistan. The first decade of 21st century increases the 0.7°C temperature of the world and optimistically 4°C temperature increases at the end of 21st century. The temperature at the end of 19th century rise up to 0.3°C-0.6°C [13].

The annual loss of maize in developing countries is approximately 10 million tons and affected the 140 million people [15]. Plants reach early at a maturity stage at high temperature due to disturbance in many biochemical reactions [5]. The high temperature slows down the chlorophyll biosynthesis and photosynthetic activity [3]. The objective of this research to indicate the vernalized and optimum temperature range for maize growth in southern Punjab of Pakistan. This study helps to understand the relationship between temperature and biochemical reactions in plants.

Materials and Methodology

Sample seeds of maize (Pak 1 Gloi) were collected from seed corporation Bahawalnagar. Experiment performed in CBD with triplicates in the Botanical Garden of The Govt. Sadiq College Women University Bahawalpur. The seeds placed in petri-dish

* Corresponding Author :

E-mail: toqeerfqw@gmail.com

and incubated at 60°C for 24hrs in an oven and some seeds placed in a refrigerator at 6°C and 0°C. The remaining seeds were stored at room temperature (35°C) for further use. Moisture content of seeds was measured before sowing. The germination % was measured after emergence and measured the morphological, anatomical and physiological attributes. The morphological parameters were measured with meter scale and weight of plant on electronic balance.

Leaves of maize plant collected early morning at 28°C for chlorophyll content analysis before cutting of final harvest. The 100mg of fresh leaves and 10ml of 80% acetone and distilled H2O crushed with pestle and mortar respectively. The solution is centrifuged at 3000rpm for 10mins and read the absorbance at 645nm and 663nm wavelength. Take the supernatant and discard the pellet. The chlorophyll content is finding out by using Arnold equation (1949).

The plants were preserved in FAA solution after final harvest for anatomical study. For staining purpose the sections were taken from the FAA solution and cut. After sections cutting, these were mounted on watch glass for staining purpose. For staining, sections were dehydrated first by alcohol. Different concentrations of alcohol were used like 10%, 30%, 50%, 70%, 90% and 100%. Safranin and Fast green were used as dyes. Sections were observed under microscope at 3 magnifications (4X, 10X and 40X) after staining.

Statistical analysis was made by using SPSS 16. 0. ONE WAY ANOVA with tuckeys test was applied to determine the significant difference of different levels of stress treatments. The difference of effects of four treatments was measured by graphical representation.

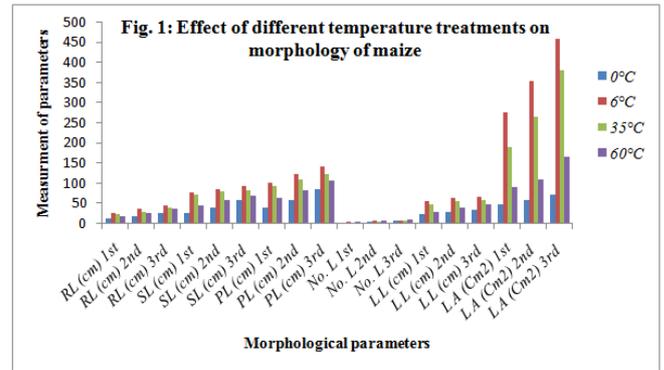
Results and Discussion

The moisture content of seeds decreased 33% due to drying in oven before sowing. The germination percentage of four treatments 0°C, 6°C, 35°C, 60°C is 33%, 87%, 64% and 53% respectively. The anatomical and physiological parameters were studied at the end of final harvest. A vernalized plant has shown the highest values in all studied (morphological, physiological and anatomical) parameters except no. of leaves. No. of leaves were high in heat stressed plants and reach early at maturity stage than other plants. The yield of four different treatments is 175gm, 320gm, 291gm and 235gm respectively.

Plants from vernalized seeds were grown three days earlier than other plants. The vernalized seeds showed the thick stem, root and broad leaves after emergence. Vernalized seeds had shown the highest value in studied anatomical parameters than other two treatments. Holland et al., (2002) [7] reported that the emergence period of oat is shorten after low temperature treatment. The heat shock disturbed the cell division and many biochemical reactions in maize plants. The high temperature causes the thermal injury in maize. Rasul et al., (2011) [7] described that the high temperature affect the plant growth until the optimum moisture content is available. 30-46% reduction in crops is predicted at the end of 21st century.

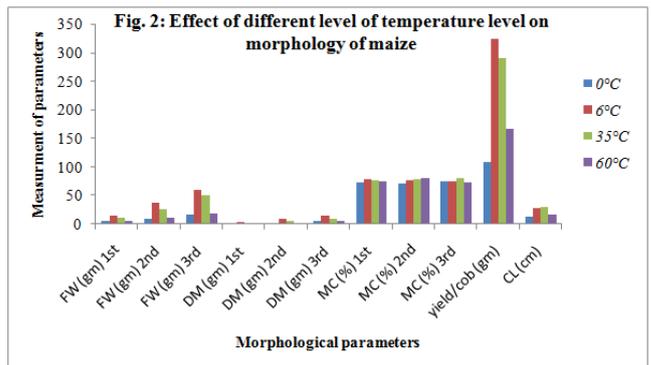
FIGURES

Fig -1



Legends= RL, Root length; SL, Shoot length; PL, Plant length; No. L, No. of leaves; LL, Leave length; LA, Leave area

Fig -2



Legends= FW, Fresh weight; DM, Dry matter; MC, Moisture content; CL, Cob length

Fig -3

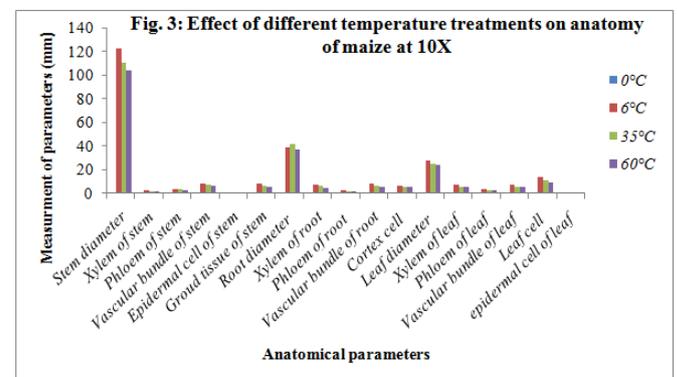


Fig. 4

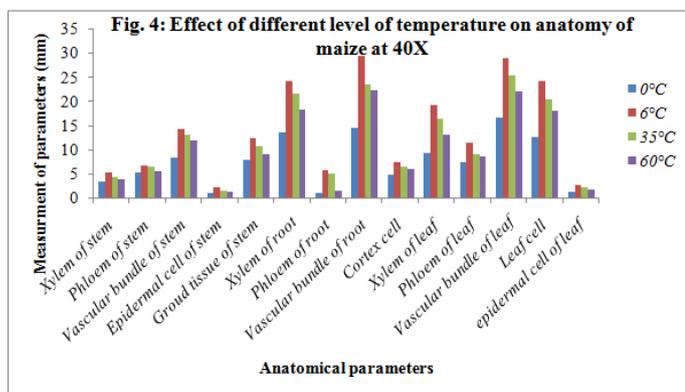
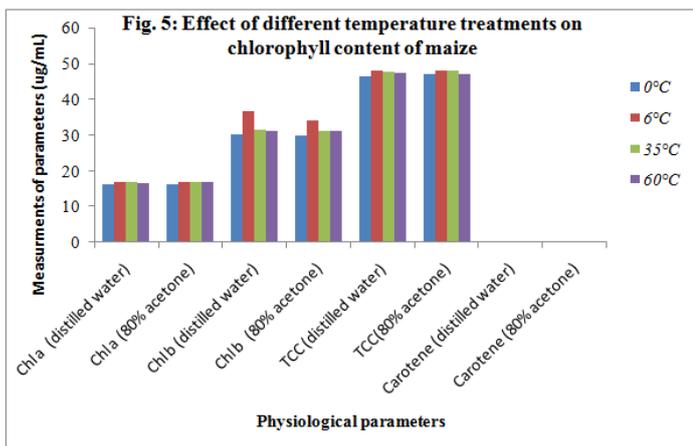


Fig. 5



Conclusion

From present study it is concluded that the vernalization or low temperature treatment at (6°C) stimulate the plant growth and emergence process of maize. Due to seed vernalization, coming out of shoot and root from maize seeds are earlier than other seeds which treated at 0°C, 35°C and 60°C for 24 hrs. The heat shock and chilling treatment on seeds shows the bad effect on plant growth and emergence processes because it disturbs the many morphological and anatomical aspects of maize seeds. Moisture content of seeds 33% decreases due to heat stress. Vernalized plants show the highest values in all morphological, anatomical and physiological parameters except no. of leaves than other treated plants. The growth period between emergence and flowering decreases due to applying the artificial low temperature or vernalization of seeds.

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