

AGRICULTURAL PRIORITIES

Editor

Assist. Prof. Dr. Sevilay GÜL

İKSAD Publishing House

AGRICULTURAL PRIORITIES

EDITORS

Assist. Prof. Dr. Sevilay GÜL

AUTHORS

Prof. Dr. Canan ŞEN

Prof. Dr. Mehmet Ufuk KASIM

Prof. Dr. Rezzan KASIM

Prof. Dr. Şifa TÜRKOĞLU

Assoc. Prof. Dr. Erol ORAL

Assoc. Prof. Gürkan DEMİRKOL

Assist. Prof. Dr. Hasret GÜNEŞ

Assist. Prof. Dr. Fevzi ALTUNER

Assist. Prof. Dr. Sevilay GÜL

Doctor of Philosophy Özge DEMİREL

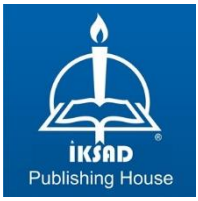
Agricultural Engineer Murat KOÇAK

Phd. Kevser KARAGÖZ SEZER

Mehtap ÖZTEKİN

Necati ŞİMŞEKLİ

Oğuz DEMİRKIRAN



Copyright © 2023 by iksad publishing house

All rights reserved. No part of this publication may be reproduced, distributed or transmitted in any form or by
any means, including photocopying, recording or other electronic or mechanical methods, without the prior written permission of the publisher,
except in the case of
brief quotations embodied in critical reviews and certain other noncommercial uses permitted by copyright law. Institution of Economic Development and Social
Researches Publications®
(The Licence Number of Publicator: 2014/31220)
TÜRKİYE TR: +90 342 606 06 75
USA: +1 631 685 0 853
E mail: iksadyayinevi@gmail.com
www.iksadyayinevi.com

It is responsibility of the author to abide by the publishing ethics rules.
Iksad Publications – 2023©
ISBN: 978-625-367-317-8
Cover Design: Mehmet Fırat BARAN
October / 2023
Ankara / Türkiye
Size = 16 x 24 cm

CONTENTS

PREFACE……..…….....1

CHAPTER I

FIRST DETECTION OF THE EFFECT OF CLIMATE CHANGE ON NATURAL SPECIES IN RANGELANDS: DETERMINATION OF HABITAT REQUIREMENTS AND PHENOLOGICAL PERIODS OF *AGROPYRON CRISTATUM* (L.) GAERTN. SUBSP. *PECTINATUM* (M. BIEB.) TZVELEV, *ARTEMISIA SCOPARIA* WALDST. & KIT., *BASSIA SCOPARIA* (L.) A.J. SCOTT

Phd. Kevser KARAGÖZ SEZER

Mehtap ÖZTEKİN

Necati ŞİMŞEKLİ

Oğuz DEMİRKIRAN.....3

CHAPTER II

AN OVERVIEW OF *IN VIVO* AND *IN VITRO* GENOTOXICITY TESTS IN EUKARYOTES

Prof. Dr. Şifa TÜRKOĞLU.....29

CHAPTER III

PERFORMANCE OF SOME TURFGRASS SPECIES SOWN PURE AND MIXED IN TURKEY

Agricultural Engineer Murat KOÇAK

Prof. Dr. Canan ŞEN.....43

CHAPTER IV

A REVIEW ON THE RELATIONSHIP BETWEEN PASTURE BIODIVERSITY AND MEAT AND MILK QUALITY OF GRAZING LIVESTOCK

Prof. Dr. Canan ŞEN.....57

CHAPTER V

CALCIUM AND POTASSIUM APPLICATIONS IN ADDITION TO STANDARD FERTILIZATION INCREASE YIELD IN CUCUMBER
Prof. Dr. Rezzan KASIM

Prof. Dr. Mehmet Ufuk KASIM…….…….....83

CHAPTER VI

ABIOTIC AND BIOTIC STRESS FACTORS IN GRAINS
Assoc. Prof. Dr. Erol ORAL

Assist. Prof. Dr. Fevzi ALTUNER.....115

CHAPTER VII

PHYSIOLOGICAL MECHANISMS OF FORAGE CROPS UNDER SALINITY STRESS
Assoc. Prof. Gürkan DEMİRKOL.....129

CHAPTER VIII

REDUCING CATTLE METHANE EMISSIONS BY FEED ADDITIVES: AN OVERVIEW
Assist. Prof. Dr. Sevilay GÜL.....143

CHAPTER IX

THE ROLE OF DIGITAL AGRICULTURE APPLICATIONS IN MITIGATING GLOBAL PROBLEMS AS A NEW PERSPECTIVE
Assist. Prof. Dr. Hasret GÜNEŞ

Doctor of Philosophy Özge DEMİREL.....163

CHAPTER X

BıOCHAR EFFECT: PLANT RESISTANCE TO BIOTIC AND ABIOTIC STRESSES
Assist. Prof. Dr. Hasret GÜNEŞ.....193

PREFACE

A sustainable agricultural sector is becoming increasingly necessary as a result of climate change. Determining priority research fields is essential for the sustainable development of agriculture because there are still knowledge gaps and a need for technologies that assist farmers in the sustainability transition. Cross-cutting strategic agricultural priorities include combating climate change through climate smart agriculture, forestry, and clean energy, advancing racial justice, equity, opportunity, and rural prosperity, developing more and better market opportunities, and addressing food and nutrition insecurity. On a planet with limited resources and in a climate that is changing, more food needs to be produced sustainably. The 'digitalization of agriculture' may be able to offer fresh answers to these difficult problems as a result of the development of technologies, computing capacity, and analytics. Science has a responsibility to provide evidence for and assist the design and usage of digital technologies in order to achieve these positive results and prevent unforeseen consequences. The question of whether agriculture can enhance human nutrition is controversial. Integrating beneficial plant microbiomes—those that promote plant growth, nutrient usage effectiveness, abiotic stress tolerance, and disease resistance—into agricultural production is one strategy to help achieve these objectives. Understanding and controlling plant-microbiome interactions in the context of contemporary agricultural systems will necessitate a massive effort by academic researchers, industrial researchers, and farmers.

CHAPTER VI

ABIOTIC AND BIOTIC STRESS FACTORS IN GRAINS

Assoc. Prof. Dr. Erol ORAL[1]
Assist. Prof. Dr. Fevzi ALTUNER[2]

DOI: https://dx.doi.org/10.5281/zenodo.8415120

[1] Van Yüzüncü Yıl University, Faculty of Agriculture, Department of Field Crops/Campus-Van-TURKEY. eroloral@yyu.edu.tr. ORCID ID: 0000-0001-9413-1092
[2] Van Yüzüncü Yıl University Gevaş Vocational School Department of Plant and Animal Production. Gevaş-Van-TURKEY. fevzialtuner@yyu.edu.tr. ORCID ID: 0000-0002-2386-2450

1.INTRODUCTION

It is known that people in the world mix a large part of their daily calorie needs from cereals and products obtained from cereals. As a result of breeding studies carried out in order to meet the need in parallel with the increasing population, varieties and genotypes with high yield per unit area have been developed. However, despite all these studies, increasing global warming and the abiotic and biotic stress factors that arise due to this affect production negatively. The word stress, which is an inevitable part of life, is derived from the Latin verb "estrictia". Stress; It appears as a term that means disaster, pressure, trouble, trouble, grief, pressure, difficult, and causes undesirable changes in the external and physiological structure of the living thing (Cufta, 2016). If we consider stress as physical and biological stress; Physical stress is expressed as the change in the size of the object against the force applied to any object. Biological stress (Levitt, 1980) is expressed as the negative effects of plant development and growth due to changes in the habitat of plants due to environmental conditions. These stress factors include drought, salinity, high and low temperature, flood, radiation, heavy metals, oxidative stress, wind, nutrient deficiency, disease and pests. These stresses can negatively affect the growth and development or productivity of plants.

Factors that cause stress situations in cereals, which have an important place in plants, can be evaluated in two large groups. These are biotic stress factors (other living organisms, animals, insects, plants, fungi, bacteria, pathogens, etc.) and abiotic stress factors (physical and chemical factors such as temperature, solar radiation, drought, flood, salinity, etc.). Among these stress factors, the most common types of stress in plants are: heat stress (high temperatures cause physiological and metabolic damage), stress due to lack or excess of light (they need light and sun), stress produced by infections caused by pathogens, pests and viruses (The application of chemical treatments can also be stressful depending on the conditions in which they are applied), stress caused by a lack or excess of nutrients (excess such as nitrogen and phosphorus also have negative effects), salt stress (can be caused by excess salt in the soil or irrigation water) and water stress are the main causes of plant death.

In studies to be carried out for this purpose, the determination of protective measures by investigating stress physiology in grains will contribute to the preservation of yield and quality (Korkmaz and Durmaz, 2017). Abiotic stress factors such as drought, salinity, extreme temperatures, chemical toxicity and oxidative stress are serious adverse events that cause interruption of activities that threaten agricultural production and deterioration of the environment.

In similar studies, stress-induced yield reductions in many crop plants, especially cereals, were found to be more than 50% (Wang et al., 2004). Analyzing the situations that occur in the life cycle as well as how plants respond to non-living abiotic stress conditions will help in the development of new approaches (Wasternack, 2007).

In this study, determinations on how adverse conditions caused by abiotic stress conditions on grains affect yield and quality parameters are included.

2.ABIOTIC STRESS FACTORS

2.1.Water Stress

Water stress (Drought Stress) occurs when the water lost by transpiration in plants in a certain period of time exceeds the amount of water taken from the environment. Competition for water intake begins between plant tissues with reduced water content. In other words, the water balance between plant tissues is disturbed. In this case, the stress can be daily or long-term. Cell growth is negatively affected due to loss of turgor in the stress state, and cells remain small (Oliver et al., 2000). The decrease in cell growth also affects wall synthesis. While protein and chlorophyll are negatively affected, seeds seem to lose their germination ability. Photosynthesis and respiration slow down or stop (Yüksel and Aksoy, 2017). The regression in cell growth causes leaves to shrink and photosynthesis production to decrease. Lack of sufficient water negatively affects the material transport in the xylem and phloem, causing the fruits to remain small, while in cereals the seeds (grains) cannot be plump and the product quality decreases (Cabello et al., 2014).



Figure 1: Wheat under water stress (Todorova et al., 2021).

2.2.Temperature Stress

Heat stress is a stress factor that negatively affects the growth and development of plants. There is a suitable temperature range for the growth and development of plants. If the temperature is too cold for the plant, it can lead to cold stress, also called cooling stress. Extreme forms of cold stress can lead to frost stress. High temperature stress damages the physiological and biochemical functions of grains and causes a decrease in growth, product and quality. Each cereal species has an optimum temperature range in which it functions optimally, and outside this range, cellular metabolism and thus plant growth are adversely affected (Burke et al., 1990). This species-specific temperature range is defined as the "thermal kinetic window" (Burke et al., 1988). Temperatures above the optimum temperature range cause changes in many physiological functions including photosynthesis, membrane integrity and enzyme stability (Nguyen et al., 1992).

2.3.Oxidative Stress

Oxidative stress in plants is a condition that occurs as a result of the accumulation of reactive oxygen species (ROS) in cells (Schweitzer and Schmidt, 2003) ROS in plants can occur during photosynthesis or under environmental stress factors. When the antioxidant defense system is not sufficiently activated, ROS can damage cellular components and this is known

as oxidative stress. Plants have an effective antioxidant defense system to protect themselves from the toxic effects of AOTs. Enzymatic and non-enzymatic components of this system prevent the formation of AOTs or detoxify AOTs after they are formed, thus protecting cellular structures from oxidative stress damage (Foyer and Noctor, 2005).

2.4.Salt Stress

Salt stress inhibits the growth and development of plants by causing osmotic and ion stress. With the increase in salt content, osmotic stress occurs first. This results in a reduction in the amount of usable water(Photo 2). This is called physiological drought. The decrease in the amount of usable water causes the cell expansion to decrease and the shoot growth to slow down (Glenn et al., 1997). Toxic effects such as inhibition of mitosis and inactivation of some enzymes are observed (Demir and KocaÇalışkan, 2002). In the ion stress phase that occurs after the osmotic stress, increasing Na and Cl ions in the environment, necessary nutrients such as K, Ca and NO3-2, and competition cause nutrient deficiency. In the environment where salt stress is experienced, the ions that cause the most toxicity in plants are sodium (Na) and chlorine (Cl) ions (Maas, 1986). Salt stress generally occurs in plants for two reasons. Firstly, the plant has difficulty in taking up water due to the increase in density as a result of the excess of dissolved salts in the root zone and it has toxic effects due to the increase in the amount of some ions. Secondly, excessive salt stress causes stunting and regression in root growth in plants. In addition to these effects, nutritional imbalance in plants, the effect of ions in the soil solution and combinations of all factors also cause adverse effects on plants (Ashraf, 1994; Marschner, 1986).



Figure 2: Wheat on salt stress (Oral, E., 2022).

2.5.Radiation Stress

Radiation stress in plants is one of the environmental factors that can occur at any stage of the plant's life, but can cause different reactions, in other words, it affects plants with different characteristics. Radiation stress can adversely affect the growth and development of plants. Radiation stress in plants can cause DNA damage in plant cells. This damage can adversely affect the growth and development of the plant. An increase in the activity of antioxidant enzymes can be observed in plants exposed to radiation stress. These enzymes can help protect the plant against radiation stress. Perception of Ultraviolet-B (UV-B) radiation, a component of sunlight, regulates photomorphogenesis, including hypocotyl elongation inhibition, cotyledon expansion, and flavonoid accumulation (Yadav et al., 2020). However, high intensity, continuous full wavelength UV-B damages plants and leads to abnormal plant growth and development, which is called UV-B stress. UV-B stress affects DNA synthesis and DNA replication by forming pyrimidine dimers, resulting in heritable variation (Britt, 1995). In addition to causing direct DNA damage, UV-B forms reactive oxygen species, resulting in oxidative stress and the oxidation of lipids and proteins. Too much UV-B causes cell death, resulting in wilting, yellowing, and abnormal growth. UV-B stress also impairs photosynthesis (Hideg et al., 2013). With longer exposure to UV-B irradiation, the maximum quantum yield of photosystem II (Fv/Fm) decreases continuously (Sztatelman et al., 2015).

2.6.Magnetic and Electrical Stress

Magnetic and electrical stresses are among the abiotic stress factors that plants are exposed to. While the magnetic field can positively affect the number of leaves, leaf area, petiole length, tillering and root length in plants, it can negatively affect the fresh and dry root weight. There is not much information about the effect of electrical stresses on plant growth (Gremiaux et. al., 2016; Vian et al., 2016). However, the effects of electromagnetic pollution on plant development and metabolism have attracted the attention of scientists in terms of both the fact that plants are the food source of humanity and their importance for the environment.

2.7.Stress due to nutrient deficiency

Stress caused by nutrient deficiency in plants can be summarized as nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc, copper and manganese deficiencies. These deficiencies can adversely affect the growth and development of plants. A lack of nutrients in plants can inhibit the growth and development of plants. Many problems can arise due to nutrient deficiency in plants. Nutrient deficiency symptoms in plants indicate which nutrient deficiency the plant is experiencing. For example, in a nitrogen deficiency, the leaves of plants turn yellow and turn pale. Root development slows down in plants with phosphorus deficiency and the maturation of the plant is delayed. In the absence of potassium, the leaves have a burnt appearance from the tips. In plants deficient in calcium, the leaf tips dry out and many flowers remain in baskets. In magnesium-deficient plants, leaves become thin and brittle; They lose their color at the ends and in the region between the veins, and take on a pale green color.Mineral nutrients absorbed in the inorganic form are indispensable for plant growth and development. The various processes underlying yield formation in crops such as biomass accumulation and its partitioning, are directly regulated by nutrient supply. Plants essentially require 17 elements for the production of optimum biomass and yield, while some additional elements are beneficial for their survival under stress and/or improvement in quality of economic produce. The relationship between nutrient supply and yield was well established by Mitscherlich (1947) and is known as the ‘Law of diminishing yield increment’. This law

states that if the supply of a particular nutrient is increased, it will cause non-availability of other nutrients or the limitation of genetic potential of crops, resulting in no increase or even a decrease in yield. Furthermore, it is observed that when a particular nutrient is supplied in abundance, the decrease in yield could be due to physiological factors, toxicity or induced deficiency of other nutrients within the plant, or in the soil, and interactions with other elements.

For example, excess supply of nitrogen (N) to cereals causes lodging thereby reducing yield. Another example of induced toxicity is where excess nickel (Ni) supplementation displaces magnesium (Mg^{2+}) ions from Rubisco, resulting in a loss of enzyme activity (Wildner and Henkel, 1979; Van Assche and Clijsters, 1986). Likewise, higher tissue concentrations of zinc (Zn) reduce the uptake of phosphorus (P) and vice-versa (Mohammed et al. 2021). Nutrient availability in soil is primarily dependent on the pH of the soil solution, which is very often altered by the presence of excess amounts of some nutrients. For example, in acid soils with high aluminium (Al^{3+}) and iron (Fe^{3+}) content, the availability of inorganic P to plant roots is restricted. Therefore, to achieve optimal growth and potential yield of crops, not only nutrient deficiencies but also excesses or toxicity stresses need to be taken into consideration. The concentration of any particular nutrient in plant tissues beyond the critical threshold level, either in the deficit or the toxic zone, will result in decline in yield and quality(Pandey et al., 2021).

3.BIOTIC STRESS FACTORS

Biotic stress factors in plants; are stress factors caused by living organisms such as plant diseases, pests and weeds. These factors can adversely affect the growth and development of plants. plant diseases; It can be of many different types such as root rot, leaf spots, rust disease, powdery mildew disease, blight disease, brown rot disease. However, different mechanisms have been developed with research approaches to overcome biotic stresses. The biotic stresses in plants can be overcome by examining the genetic mechanism of the agents causing these stresses. Genetically modified plants have proven to make great efforts against biotic stresses in plants by developing resistant crop plants varieties (Gull et al., 2019).

4.RESULT AND RECOMMENDATION

There are many methods to protect cereals from biotic and abiotic stress factors. The morphological, anatomical and metabolic responses of plants to stress factors have led to the emergence of natural selection in the evolution process. Stress response mechanisms contribute to stress resistance or stress tolerance at different morphological, biochemical and molecular levels. Among the stress response mechanisms in cereals; activation of antioxidant enzymes, osmotic regulation, regulation of photosynthesis activity, regulation of hormones and change of gene expression. In this case, environmental stress factors have an important place among the main factors that provide the structural and functional shaping of plants. The concept of stress in plants is actually a term used in physics. However, it has also been defined in different ways in the biological sense. It is thought that effective strategies and mechanisms to cope with environmental stresses caused by biotic or abiotic factors will contribute by knowing these factors and understanding their mechanisms.

REFERENCES

Ashraf, M. (1994). Breeding for Salinity Tolerance in Plants. Critical Reviews in Plant Sciences 13, 17–42

Britt A.B. (1995). Repair of DNA damage induced by ultraviolet radiation. Plant Physiology. 108: 891–896

Burke, J.J., Mahan, J.R., Hatfield, J.L. (1988). Crop-Specific Thermal Kinetic Windows in Relation to Wheat and Cotton Biomass Production, Agron. J., 80, 553-556.

Burke, J.J., (1990). High Temperature Stress and Adaptation in Crops, In: Alscher, R.G., Cummings, J.R. (Eds.), Stress Response in Plants: Adaptation and Acclimation Mechanisms, pp.295-309, WileyLiss, New York.

Cabello, J.V., Lodeyro, A.F., Zurbriggen, M. (2014). Novel perspectives for the engineering of abiotic sress tolerance in plants. current Opinion Biotechnology. 26: 62-70.

Ćufta, M. (2016). Stres ve Dini İnanç. Pamukkale Üniversitesi İlahiyat Fakültesi Dergisi, (5): 50-70.

Demir, Y., Kocaçalıskan, İ. (2002). Effect of NaCl and Proline on Bean Seedlings Cultured invitro. Biologia Plantarum, 45 (4): 597-599.

Foyer, C.H., Noctor, G. (2005). Redox homeostasis and antioxidant signaling: a metabolic interface between stress perception and physiological responses. Plant Cell. 17: p. 1866-1875

Glenn, E.P., Brown, J.J., Khan, M.J. (1997). Mechanisms of Salt Tolerance in Higher Plants., Edited by Basra, A.S., and Basra, R.K. Mechanisms of Environmental Stress Resistance in Plants'', Harwood Academic Publishers, 83-110.

Gremiaux, A., Girard, S., Guérin, V., Lothier, J., Baluska, F., Davies, E., Bonnet, P., Vian, A. (2016). Low-amplitude, high-frequency electromagnetic field exposure causes delayed and reduced growth in Rosa hybrida, Journal of Plant Physiology, 190, 44-53.

Gull, A., Lone, A.A., Wani, N.U.I. (2019). Biotic and Abiotic Stresses in Plants. https://www.intechopen.com/chapters/66714. Hideg E, Jansen MA, Strid A. (2013). UV-B exposure, ROS, and stress: inseparable

companions or loosely linked associates? Trends Plant Sci 18: 107–115.

Korkmaz, H., Durmaz, A. (2017). Bitkilerin Abiyotik Stres Faktörlerine Verdiği Cevaplar. GÜFBED/GUSTIJ. 7 (2): 192-207.

Levitt, J. (1980). Response of plants to environmental stresses: chilling, freezing, and high temperature stresses. Physiological ecology: a series of monographs, texts, and treatises, 1, 23-64.

Maas, E.V. (1986). Salt Tolerance of Plants. Applied Agricultural Research 1 (1):12-26.

Marschner, H. (1986). Mineral Nutrition in Higher Plants. Academic Press, London, 477–542.

Mitscherlich, E.H. (1947). Results of more than 27,000 field tests with fertilizers. Zeitschrift Pflanzenernährung Düngung Bodenkunde, 38, 27–35.

Mohammed, S.B., Dzidzienyo, D.K., Yahaya, A., Umar, M.L., Ishiyaku, M. F., Tongoona, P.B., Gracen, V. (2021). High soil phosphorus application significantly increased grain yield, phosphorus content but not zinc content of cowpea grains. Agronomy, 11, 802.

Nguyen, H.T., Joshi, P.C. (1992). Molecular Strategies for The Genetic Dissection of Water and High Temperature Stress Adaptation in Cereal Crops, Proceedings of an International Symposium on the Adaptation of Food Crops to Temperature and Water Stress, , Taiwan, 119, 13-18 August,

Oliver, M.J., Tuba, Z., Mishler, B.D. (2000). Evalution of desiccation tolerance in land plants. Plant Ecol., 151; 85-100.

Pandey, R., Vengavası, K., Hawkesford, M.J. (2021). Plant adaptation to nutrient stress. Plant Physiology Reports, volume 26: 583–586.

Schweitzer, C., Schmidt, R. (2003). Physical mechanisms of generation and deactivation of singlet oxygen. Chemical Reviews. 103: p. 1685-1757.

Sztatelman O, Grzyb. J., Gabrys, H., Banas, A.K. (2015). The effect of UV-B on Arabidopsis leaves depends on light conditions after treatment. BMC Plant Biol 15: 281.

Todorova, D., Sergiev, I., Katerova, Z., Shopova, E., Dimitrova, L., Brankova, L. (2021). Assessment of the biochemical responses of wheat seedlings

to soil drought after application of selective herbicide. Plants, 10(4), 733; https://doi.org/10.3390/plants10040733

Van Assche, F., Clijsters, H. (1986). Inhibition of photosynthesis in Phaseolus vulgaris by treatment with toxic concetration of zinc: effect on ribulose-1,5-bisphosphate carboxylase/oxygenase. Journal of Plant Physiology, 125, 355–360.

Vian, A., Davies, E., Gendraud, M., Bonnet, P. (2016). Plants responses to high frequency electromagnetic fields, Biomed Research International, 2016, 1-13.

Wang, W., Vinocur, B., Shoseyov, O., Altman, A. (2004). Role of plant heat-shock proteins and molecular chaperones in the abiotic stress response, Trends in Plant Science, 9(5), 244-252.

Wasternack, C. (2007). Jasmonates: An update on biosynthesis, signal transduction and action in plant stress response, growth and development, Annals of Botany, 100, 681-697.

Wildner, G.F., Henkel, J. (1979). The effect of divalent metal ion on the activity of Mg2+-depleted ribulose-1,5-bisphosphate oxygenase. Planta, 146, 223–228.

Yadav, A., Singh, D., Lingwan, M, Yadukrishnan, P., Masakapalli, S.K., Datta, S. (2020). Light signaling and UV-B-mediated plant growth regulation. J Integr Plant Biol 62: 1270–1292.

Yüksel., B., Aksoy, Ö. (2017). Su stresi koşullarında bitkilerde gözlenen değişimler. Turkish Journal of Scientific Reviews, 10 (2): 01-05.