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Role of Potential Plant Hormones for Activation and Enhancing Physiological Processes, Growth and Development

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Abstract

Plant hormones are chemicals that are present in small amounts, influence and promote the division, growth, and maturation of cells and tissues. Salicylic acid is a phenolic phytohormone and has a function in growth/development, photosynthesis, transpiration, ion absorption, and transport. By interfering with endogenous signals, SA mediates plant defense against pathogens. It strengthens the body's defenses against infections by promoting the production of pathogenesis-related proteins. It affects the systemic acquired resistance (SAR) pathway, wherein a pathogenic assault on one. Water deficiency affects during tillering, head emergence, filling of grain and maturity water deficiency of wheat. Concentration of carotenoids more during drought stress and that produced for drought tolerance enhancement in bread wheat. Water shortage on pigment contents of photosynthesis, relative water amount, shot weight in dried form, flag leaf area specific mass, parameters for gas exchange, physiological parameters and yield. Drought there more significant reduction in tillers/plant, fertile tillers/plant, length of spike, yield/spike and thousand kernel weight of wheat cultivars during drought conditions as compared with normal irrigation conditions. Polyamine exogenously via spray during grain filling condition. The water deficiency spermidine and spermine reduced the inhibition caused by water deficiency when polyamine had applied.

Keywords: Plant hormones, influence, division, growth, hormonal systems, tissues.

INTRODUCTION

Plant hormones are chemicals that, when present in small amounts, influence and promote the division, growth, and maturation of cells and tissues. They do not qualify as nutrients. Plant hormones are often generated diffusely within plant tissues and are not often localized. Plants use more passive techniques to transport chemicals throughout their bodies, in contrast to mammals, who have two circulatory systems (cardiac and lymphatic), each powered by a heart that pumps fluids throughout the body [1, 2]. For this reason, they lack glands to manufacture and store hormones. Plants employ simple molecules like hormones because their tissues can absorb them more readily. Within the institution, they are often developed and used locally [1-3].

Examining the early stages of fruit development is one way to focus on auxin's role in flower development. Gynoecium ontogeny is regulated by an auxin gradient in the gynoecium primordium. The gynophore development is supported by the lowest basal levels, the ovary is designed by the medial levels, and the style and stigma are specified by the high levels at the tip. Through genetic or pharmacological modification of PAT, the apical–basal pattern of gynoecium organ development is altered. This presumably affects the threshold bounds of auxin necessary for each gynoecium tissue type. Furthermore, polymorphisms in many transcription factors associated with auxin signaling lead [4-6].

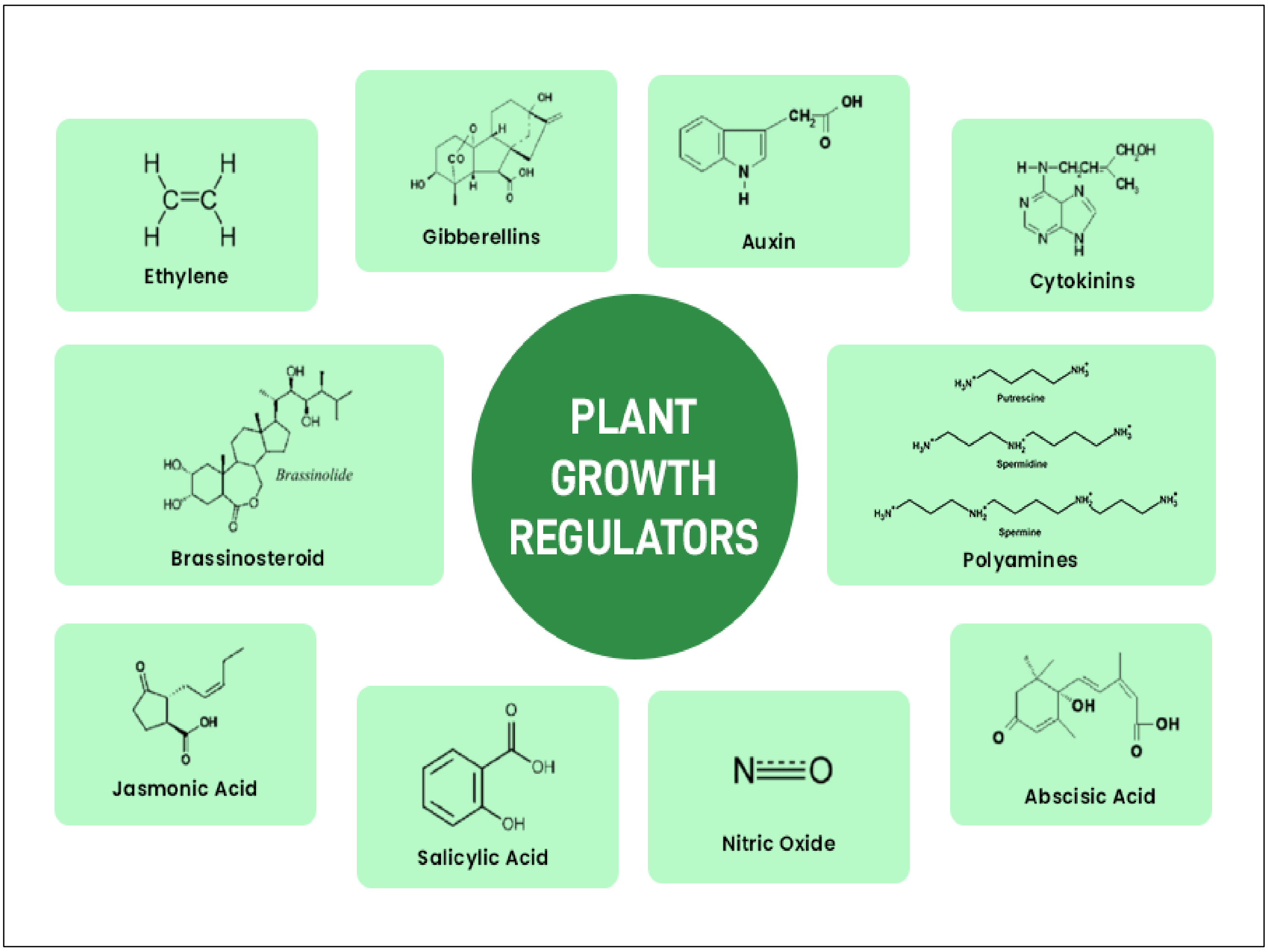

Fig-1: Plant hormones influence and promote the division, growth, and maturation of cells

Hormones, environmental conditions, and physiological processes, growth and development

Significant amounts of SA are gathered by infected plants. SA is a phenolic phytohormone and has a function in growth/development, photosynthesis, transpiration, ion absorption, and transport. In a bark extract from Salix, salicin, a glucoside of SA, has been utilized as an analgesic. Aspirin, also known as acetylsalicylic acid, to the market as a pharmaceutical for the treatment of fever, inflammation, and discomfort [7, 8]. By interfering with endogenous signals, SA mediates plant defense against pathogens. It strengthens the body's defenses against infections by promoting the production of pathogenesis-related proteins. It affects the systemic acquired resistance (SAR) pathway, wherein a pathogenic assault on one [9-11].

A family of compounds known as SLs are created by the roots of plants. When parasitic plants grow in the roots of their host plants, such as *Striga lutea* and other members of the Striga genus, SLs help them germinate. SLs are essential to the identification of the plant by symbiotic fungus because they establish a mutualistic relationship with these plants and provide phosphate and other soil nutrients. SLs stop shoot branching in plants in addition to encouraging the growth of lateral roots and the elongation of root hairs. The structure of naturally occurring canonical SLs is based on a tricyclic lactone and a hydroxymethyl butanolide [7-11].

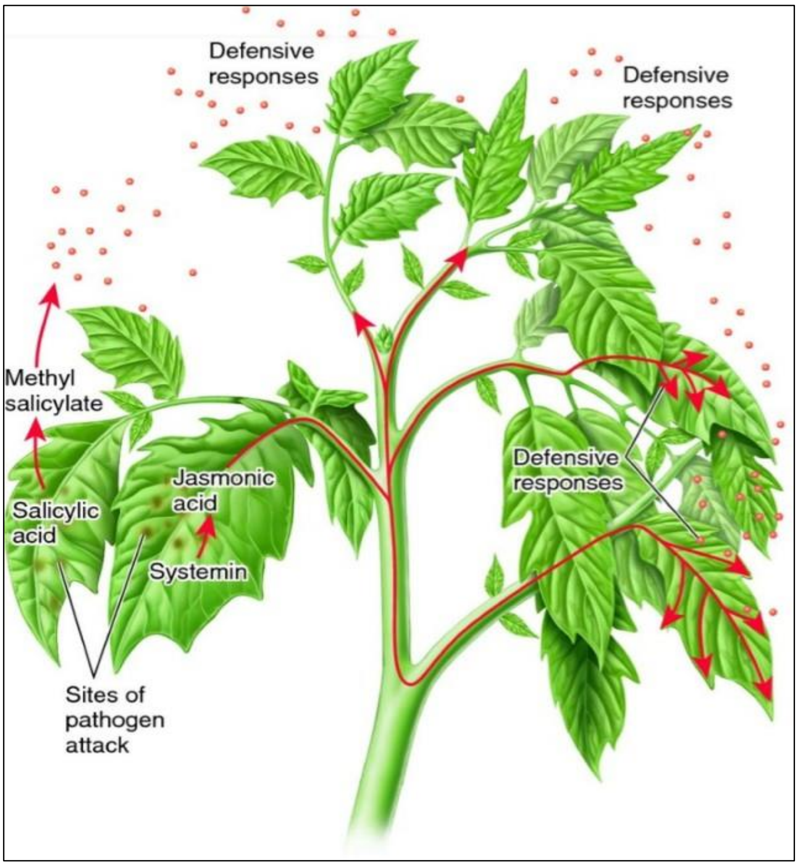

Fig-2: Salicylic acid promote the division, growth, and maturation of cells

Water deficiency affects during tillering, head emergence, filling of grain and maturity water deficiency of wheat. It had observed that production had declined during growth water deficiency. Drought there had during tillering, during head emergence and reduction during grain filling water deficiency. It had also conducted that the effect of water deficiency had changing and depended on growth stages of wheat plant and continuance and strength of plants [12, 13]. Water shortage impacts on winter wheat to find the relation between grain yield and yield components. Water deficiency water deficiency conducted that drought stress reduced the spike number per meter length, biological yield, leaf area, shoot fresh weight and dry weight, kernel weight per spike and thousand kernel weight. The wheat varieties with high spike per meter length, shoot fresh weight and dry weight, biological yield and thousand grain weight water deficiency important to get yield during unfavorable environment. Wheat varieties in different water regimes under water deficit conditions. The number of tillers per plant, stomatal length, leaf morphology, vegetation index, canopy height metrics, spike length, length of peduncle, grain yield and yield per hectare water deficiency all found to be significantly different between genotypes. Stomatal length and frequency water deficiency negatively correlated. Leaf venation and stomatal occurrence water deficiency positively correlated, caused thick veins per unit area of the stomata. The low positive grain yield correlation observed for stomata opening and closing, vegetation index, canopy height metrics, peduncle length, grain yield and yield per hectare [14-16].

Drought related attributes inheritance in wheat during normal irrigation and water deficiency. For the entire cross combinations, inheritability and predicted genetic modification for tillers per plant, height of plant, maturity days, peduncle length and grain yield water deficiency high length of spike and grains number per spike water deficiency constantly low. Sixteen bread wheat germplasm under water deficit conditions. Plants water deficiency sown in RCBD with three replications. Water deficiency revealed variations in traits such as germination percentage, heading days, height of plant, length of spike, seeds numbers per spike, spikelets number/spike, seeds weight and yield of grain. Analysis of variance showed a negative correlation between spikelet numbers and grain yield and positive impact among grain numbers per spike and grain yield per plant [16-19]. Plants water deficiency laid out in randomized complete block design with four replications. The water deficiency revealed that drought stress reduced the spikelet's numbers, mean productivity and grain yield. Finally, it had conducted that some wheat germlines had tolerance to drought stress. The wheat germplasm for drought tolerance showed a negative correlation between length of spike and drought tolerance index and positive correlation between peduncle length and drought tolerance index. The wheat genotypes with high peduncle length produced more yield and could be used for breeding [11, 14, 16].

Water deficiency significantly declined the morphological characteristics, yield of grains and yield related traits. Furthermore, drought stress reduced the root surface area for anchoring and absorption, pigments and chlorophyll contents. The concentration of carotenoids the more during drought stress and that produced for drought tolerance enhancement in bread wheat. Plants water deficiency arranged in randomized complete block design having four replications. Water deficiency had applied at stage of tillering, early flowering, post flowering and terminal stage of growth. The drought water deficiency at flowering stage reduced thousand kernel weight [20, 21].

Water deficiency during milk water deficiency has drastic affect in grain formation in wheat spikelet's. Water deficiency also affected the heading and emergence of ear and water shortage during head emergence the caused the decline in yield. Vegetative growth like tillers per plant, fertile tillers, peduncle length, canopy temperature water deficiency also decreased during water deficiency. The impact of stress on grain yield and yield related components off wheat cultivars. Fourteen wheat varieties water deficiency cultivated according to a randomized complete block design in natural drought conditions and normal irrigation. Drought there the significance variance in heading day, number of maturity days, spike/plant, chlorophyll content, length of peduncle, spike length and thousand kernel weight in normal irrigation and water deficit conditions [22,23]. The morphological and physiological attributes of wheat yield related under water deficit conditions. Water deficiency revealed that there reduction in biological yield, canopy temperature depression, genetic variation and kernel number per spike. Peduncle length, thousand kernel weight and plant height had also significantly reduced under drought stress conditions. The effect of late season water deficiency on wheat genotypes had evaluated in two separate normal and drought stress conditions. There water deficiency physiological characteristics, yield and yield related attributes studied. There, the split plot layout used depend on randomised complete block design. Drought water deficiency reduced attributes of wheat like peduncle length, grain weight, grains per spike and yield of plant. Water deficiency also caused significant decline in chlorophyll content efficacy, chlorophyll *a*, *b*, c, photosynthesis process, stomatal opening and closing and process of transpiration [24-26].

Water shortage on pigment contents of photosynthesis, relative water amount, shot weight in dried form, flag leaf area specific mass, parameters for gas exchange, physiological parameters and yield. Drought water deficiency caused the decline in rate of photosynthesis, conductance of stomata, rate of transpiration, conductance of mesophyll, contents for chlorophyll pigments, shot weight in dried form, flag leaf area and relative water content in bread wheat genotypes. The water deficiency caused the reduction in physiological parameters and yield and yield components. Water deficiency indicated the higher level of coefficient of phenotypic variance and coefficient of genotypic variance for fertile tillers, length of spike, kernel number per spike, thousand kernel weight, yield of biomass, harvest index and yield of grain per plot. Mean value of genetic advance for fertile tillers/plant in normal and water deficient conditions [27-29].

Drought resistance measurements, such as geometric medium productivity and harmonic mean productivity, have been measured and calculated based on grain yield in water deficit and irrigated fields. The stress sensitivity index the measured and adjusted to account for the impact of dry-grain yields. Drought resistance indexes have the highest drought tolerance for genotypes. The heterogeneity and categorized the agricultural and morphological characters under normal water supply and water deficiency. Drought there had significant reduction in tillers/plant, fertile tillers/plant, length of spike, yield/spike and thousand kernel weight of wheat cultivars during drought conditions as compared with normal irrigation conditions. Length of root, diameter of root, fresh weight of root and dry weight of root had also declined under water deficit conditions. The impacts of water shortage on nine wheat cultivars for yield and yield components at grain filling stage. Water deficiency indicated that water deficiency at post anthesis water deficiency significantly declined the yield of grains, grain biomass, thousand grain weight and index for harvest of wheat varieties. Furthermore, terminal water deficiency declined the net rate of photosynthesis, conductance of stomata, rate of transpiration, chlorophyll a,b contents, chlorophyll a,b ratio, significantly increase the temperature of leaves and CO_2 substomatal concentration. Finally, it had concluded that wheat genotypes with higher net rate of photosynthesis, conductance of stomata and higher leaf water content are tolerant to water deficiency [30-32].

To alleviate the impacts of water deficiency during vegetative growth water deficiency by nitrogenous nutrients. Water deficiency elevated that wheat plants under severe deficiency and low nitrogen availability significantly lower deficiency the photosynthesis rate, chlorophyll contents and finally kernel yield by shortened kernel filling during post anthesis stage. While, severe water deficiency with higher concentration of nitrogen resulted tolerance to water deficiency by sustaining the higher water potential in leaf and chlorophyll contents. Furthermore, wheat plant under high nitrogen concentration showed reduced senescence, increased grain filling duration and finally grain yield [17, 19]. To evaluate the comparative effect of drought and Ultra Violet-B (UV-B) in pea and wheat plants, water deficiency indicated that relative water content (RWC) had major factor which had reducing in response to water deficiency. UV-B implementation caused greater damage to membrane, lipid per oxidation and osmolytes leakage under drought stress. Drought and UV-B comparatively affected the plant growth and yield. The impact of polyamine (PA) on wheat grain filling during drought condition, two wheat germlines differing in water deficit resistance water deficiency selected and endogenous PA concentration water deficiency computed during filling of grain under changing water regimes. Polyamine had exogenously applied via spray during grain filling condition. The water deficiency evaluated that spermidine and spermine reduced the inhibition caused by water deficiency when polyamine had applied [21, 24, 26].

Advance lines water deficiency subjected to normal irrigation and water shortage for three growing seasons. Drought there water deficiency decreased values of canopy temperature in normal irrigation indicating more rate of transpiration as compared to water shortage conditions. These lines water deficiency produced more yield under normal conditions as compared with water shortage conditions. Drought tolerance index described the recombinant inbred lines with high vegetation based dry matter and grain number per spike. The grain yield and micronutrients zinc (Zn) and iron (Fe) concentration in wheat genotypes including derived modern wheat varieties of international maize and wheat improvement center under water deficit conditions. It had conducted that grain yield, Zn and Fe concentrations and protein contents water deficiency significantly affected by high temperature and water deficiency. Zinc and protein contents water deficiency higher in water deficit environment, while Zn and Fe per unit area had more in normal environmental conditions [27, 29, 31].

Yield loss due to water shortage had very drastic. Water deficiency caused the decline installer, fertile tillers, canopy temperature, peduncle length, grains/spike and thousand kernel weight. Vegetative water deficiency and phonological water deficiency also reduced during water shortage as compared with normal irrigation conditions. The impact of drought on wheat variety, water deficiency showed there water deficiency more tillers/plant, spikelets/spike, peduncle length, seeds number, kernel weight and biological yield in three irrigated treatment. Treatment with no irrigation had applied produced low tillers, spikelets, peduncle length, spike length, kernel weight, yield and biological yield. Drought caused the yield loss of wheat in the world. Vegetation index, peduncle length, spike length, tillers/plant, grain yield, thousand kernel weight, stomatal conductance, transpiration rate and stomatal closing and opening reduced by drought [24, 25, 27].

The morphological and physiological traits of wheat cultivars in two, normal availability of water and water deficit conditions. Analysis of traits indicated that wheat cultivars had genetically diversity among all characteristics of growth. Grain yield/plant had positive correlation with yield of straw, spike length, spike length and biological yield. Finally, it had concluded that to attain the grain yield of choice, there water deficiency increased level of characters which had positive and significant correlation with the yield. Water stress effect the phenotypic and genotypic attributes of wheat at different stages of growth. Process of photosynthesis had affected by at flowering stage during water stress conditions. At tillering stage water deficiency significantly reduced the stomatal conductance, relative water content and transpiration, the most sensitive stage of plant growth. Water stress also reduced the flag leaf area, spike length and thousand grain weight [31, 32]. Plants under normal irrigation produced more seed number and maximum grain yield in all growth stages. Secondly, highest yield had shown in plants grown during water unavailability at the early growth stages and maturity. Water use components productivity had highest under water shortage at early growth stages and grain yield had minimum under that situation. Use of water irrigation at all levels except for the initial and maturity levels produced more number of grain and finally yield of plants. It had concluded wheat yield might be maximum if drought stress had minimized [33, 34].

CONCLUSION

Reactive oxygen species promote oxidative stress in systemic inflammation and plant infection, which results in endogenous lipid peroxidation of unsaturated fatty acids and ethylene production. Oxidative stress is brought on by respiratory burst in plants, which happens when bacterial and fungal diseases come into contact with a pathogen that kills plants. Because of this, a large amount of ROS is created.

REFERENCES

1. Gaspar, T., Kevers, C., Penel, C., Greppin, H., Reid, D. M., & Thorpe, T. A. (1996). Plant hormones and plant growth regulators in plant tissue culture. *In vitro Cellular & Developmental Biology-Plant*, *32*, 272-289.
2. Asami, T., & Nakagawa, Y. (2018). Preface to the Special Issue: Brief review of plant hormones and their utilization in agriculture. *Journal of pesticide science*, *43*(3), 154-158.
3. Jabłońska-Trypuć, A., Matejczyk, M., & Czerpak, R. (2016). N6-benzyladenine and kinetin influence antioxidative stress parameters in human skin fibroblasts. *Molecular and cellular biochemistry*, *413*, 97-107.
4. Wilson, R. N., Heckman, J. W., & Somerville, C. R. (1992). Gibberellin is required for flowering in

Arabidopsis thaliana under short days. *Plant physiology*, *100*(1), 403-408.
5. Xu, Y. L., Li, L., Gage, D. A., & Zeevaart, J. A. (1999). Feedback regulation of GA5 expression and metabolic engineering of gibberellin levels in Arabidopsis. *The Plant Cell*, *11*(5), 927-935.
6. Yadav, R., & Vijayraghavan, U. (2008). OsMADS1 as a transcriptional regulator of rice floral organ fate affects auxin and cytokinin signaling pathways. *Developmental Biology*, *319*(2), 587-598.
7. Tonnessen, B. W., Manosalva, P., Lang, J. M., Baraoidan, M., Bordeos, A., Mauleon, R., ... & Leach, J. E. (2015). Rice phenylalanine ammonia-lyase gene OsPAL4 is associated with broad spectrum disease resistance. *Plant molecular biology*, *87*, 273-286.
8. Torrens-Spence, M. P., Bobokalonova, A., Carballo, V., Glinkerman, C. M., Pluskal, T., Shen, A., & Weng, J. K. (2019). PBS3 and EPS1 complete salicylic acid biosynthesis from isochorismate in Arabidopsis. *Molecular plant*, *12*(12), 1577-1586.
9. Ng, L. M., Melcher, K., Teh, B. T., & Xu, H. E. (2014). Abscisic acid perception and signaling: structural mechanisms and applications. *Acta Pharmacologica Sinica*, *35*(5), 567-584.
10. Ngullie, C. R., Tank, R. V., & Bhanderi, D. R. (2014). Effect of salicylic acid and humic acid on flowering, fruiting, yield and quality of mango (Mangifera indica L.) cv. KESAR. *Advance Research Journal of Crop Improvement*, *5*(2), 136-139.
11. Pasternak, T., Groot, E. P., Kazantsev, F. V., Teale, W., Omelyanchuk, N., Kovrizhnykh, V., ... & Mironova, V. V. (2019). Salicylic acid affects root meristem patterning via auxin distribution in a concentration-dependent manner. *Plant Physiology*, *180*(3), 1725-1739. doi: 10.1104/pp.19.00130.
12. Clarke, D., Hess, T. M., Haro-Monteagudo, D., Semenov, M. A., & Knox, J. W. (2021). Assessing future drought risks and wheat yield losses in England. *Agricultural and Forest Meteorology*, *297*, 108248.
13. Dodig, D., Zorić, M., Kandić, V., Perović, D., & Šurlan-Momirović, G. (2012). Comparison of responses to drought stress of 100 wheat accessions and landraces to identify opportunities for improving wheat drought resistance. *Plant Breeding*, *131*(3), 369-379.
14. Duan, M., Wu, F., Jia, Z., Wang, S., Cai, Y., & Chang, S. X. (2020). Wheat straw and its biochar differently affect soil properties and field-based greenhouse gas emission in a Chernozemic soil. *Biology and Fertility of Soils*, *56*, 1023-1036.
15. Dutamo, D., Alamerew, S., Eticha, F., & Assefa, E. (2015). Path coefficient and correlation studies of yield and yield associated traits in bread wheat (Triticum aestivum L.) germplasm. *World Applied Sciences Journal*, *33*(11), 1732-1739.
16. Fard, A. K., & Sedaghat, S. (2013). Evaluation of drought tolerance indices in bread wheat recombinant inbred lines. *Eur. J. Exp. Bio*, *3*(2), 201-204.
17. Wasaya, A., Manzoor, S., Yasir, T. A., Sarwar, N., Mubeen, K., Ismail, I. A., ... & EL Sabagh, A. (2021). Evaluation of fourteen bread wheat (Triticum aestivum L.) genotypes by observing gas exchange parameters, relative water and chlorophyll content, and yield attributes under drought stress. *Sustainability*, *13*(9), 4799.
18. Choy, S. Y., Prasad, K. M. N., Wu, T. Y., Raghunandan, M. E., Yang, B., Phang, S. M., & Ramanan, R. N. (2017). Isolation, characterization and the potential use of starch from jackfruit seed wastes as a coagulant aid for treatment of turbid water. *Environmental Science and Pollution Research*, *24*, 2876-2889.
19. Kumar, A., Sharma, P. C., Singh, R., & Kumari, J. (2018). Bread Wheat Germplasm Evaluation for Soil Moisture Stress Tolerance under Rainfed Condition. *International Journal of Bio-resource and Stress Management*, *9*(6), 754-761.
20. Kumar, Y., Lamba, R. A. S., Balbir, S., & Vinod, K. (2014). Genetic variability, correlation and path analysis in wheat varieties under late sown condition. *Annals of Agri Bio Research*, *19*(4), 724-727.
21. Leilah, A. A., & Al-Khateeb, S. A. (2005). Statistical analysis of wheat yield under drought conditions. *Journal of Arid environments*, *61*(3), 483-496.
22. Li, Y., Ye, W., Wang, M., & Yan, X. (2009). Climate change and drought: a risk assessment of crop-yield impacts. *Climate research*, *39*(1), 31-46.
23. Liu, Y., Liang, H., Lv, X., Liu, D., Wen, X., & Liao, Y. (2016). Effect of polyamines on the grain filling of wheat under drought stress. *Plant Physiology and Biochemistry*, *100*, 113-129.
24. Lv, X., Li, T., Wen, X., Liao, Y., & Liu, Y. (2017). Effect of potassium foliage application post-anthesis on grain filling of wheat under drought stress. *Field Crops Research*, *206*, 95-105.
25. Mahalanobis, P. C. (1936). On the generalized distance in statistics. *Proc Nat Inst Sci*, 2, 49-55.
26. Mahrookashani, A., Siebert, S., Hüging, H., & Ewert, F. (2017). Independent and combined effects of high temperature and drought stress around anthesis on wheat. *Journal of Agronomy and Crop Science*, *203*(6), 453-463.
27. Mehraban, Z., Ghaffari Novin, M., Golmohammadi, M. G., Sagha, M., Pouriran, K., & Nazarian, H. (2019). Protective effect of gallic acid on apoptosis of sperm and in vitro fertilization in adult male mice treated with cyclophosphamide. *Journal of cellular biochemistry*, *120*(10), 17250-17257.
28. Mickky, B., Aldesuquy, H., & Elnajar, M. (2020). Effect of drought on yield of ten wheat cultivars linked with their flag leaf water status, fatty acid profile and shoot vigor at heading. *Physiology and Molecular Biology of Plants*, *26*, 1111-1117.

29. Miyan, M. A. (2015). Droughts in Asian least developed countries: vulnerability and sustainability. *Weather and Climate Extremes*, *7*, 8-23.
30. Sufyan, M. A., Mahmood, A., Ali, A., Maqbool, M. M., & Ahmad, M. (2013). Comparative assessment of wheat cultivars and sowing dates under agroclimate of Sheikhupura, Pakistan. *Asian Journal of Agriculture and Biology*, *1*(3), 100-104.
31. Naghavi, M. R., Toorchi, M., Moghaddam, M., & Shakiba, M. R. (2015). Evaluation of diversity and traits correlation in spring wheat cultivars under drought stress. *Notulae Scientia Biologicae*, *7*(3), 349-354.
32. Qaseem, M. F., Qureshi, R., & Shaheen, H. (2019). Effects of pre-anthesis drought, heat and their combination on the growth, yield and physiology of diverse wheat (*Triticum aestivum* L.) genotypes varying in sensitivity to heat and drought stress. *Sci Rep*, 9, 1-12.
33. Razzaq, A., Ali, Q., Qayyum, A., Mahmood, I., Ahmad, M., & Rasheed, M. (2013). Physiological responses and drought resistance index of nine wheat (Triticum aestivum L.) cultivars under different moisture conditions. *Pakistan Journal of Botany*, *45*(1), 151-155.
34. Shewry, P. R., & Hey, S. J. (2015). The contribution of wheat to human diet and health. *Food and energy security*, *4*(3), 178-202.

