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Physiology of heat and drought tolerance in wheat: An overview

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Abstract

Wheat crop often gets exposed to drought and high temperature during grain growth particularly in subtropical conditions. Physiology of wheat is adversely affected by heat stress and drought stress. Heat and drought tolerance are influenced by some of the physiological traits such as increased rates of photosynthesis, stay green, chlorophyll concentration, chlorophyll fluorescence, and so on. Under drought stress wheat yield is mostly decreased by half or less of the irrigated control. Drought stress (60% relative soil moisture content) has been found to decrease the grain yield by more reduction in the kernel weight than the grain. Hence, any efforts to improve grain yield of wheat under these stresses should consider insights into the mechanisms of grain development and also the physiological traits when plants experience terminal stress. For improvement of grain weight of wheat under abiotic stress conditions caused by drought and high temperature found that drought stress decreased the grain yield per spike by 16.2% in the tolerant cultivar and by 27.9% in sensitive cultivar. But under combined heat and drought stress, the same cultivar did not show high tolerance. High temperature significantly reduced the grain weight and number of grains in wheat. Some other studies have reported that post anthesis rise in ambient temperature resulted in reduction in individual grain weight. So, it can be concluded that for the sustainability of the agriculture heat stress and drought are the major barrier in the field.

Keywords: Heat stress, drought stress, physiological traits and wheat.

1. Introduction

Wheat is a grass which comes under the family of Poaceae. It is a prime crop as it is a major staple food across Worldwide. Wheat sowing season in India runs from October to December. Wheat is the important source of carbohydrate (Shewry PR *et al.,* 2015) and in human food it is the major source of protein found in vegetables and it is about 13% and it is comparatively higher than other cereals (Annonymous, 2016). Although wheat had been originated in South-Western Asia, but it has wide adaptability due to which it can be grown under different agro-climatic zone such as tropical zone, subtropical and temperate zone.

If it comes to wheat production India is the 2nd biggest producer of wheat with the overall area which comes under the wheat cultivation lies near about 31.5 million hectares. We all know that in among all cereal crop's wheat is the second most important, so it is important to maintain and increase its productivity but there are several factors like biotic and abiotic which can affect productivity of wheat (Joshi *et al.*,2007; Sharma *et al.*,2016). Under all the factors especially abiotic factors creating stress and limiting wheat production is periodic heat stress or continuous stress and these are considered as a major hazard in wheat, especially in subtropical regions (Reynolds *et al.,* 2016). In world there are many regions in which drought act as another major abiotic stress which unfavorably affecting synthesis of wheat.

Frequency of heat stress in wheat is increasing across the globe due to high temperature. The substantial effects of heat stress on grain setting duration and rate ultimately leads to reduction in grain yield. However, the timing, duration and intensity of heat stress determine its impact on grain yield. (Pandey *et al.,* 2019) At any stage of development stress because of heat can affect growth of wheat and future modelling scenarios forecast significantly hotter temperatures. (Easterling and Apps, 2005).

Globally, the average temperature generally increases by 0.3°C per decennium (Jones *et al*., 1998) and (Hossain *et al.,* 2013) and According to the report released by Intergovernmental Panel on Climate Change (IPCC 2014), temperatures would rise by about 0.3 degree and 1 degree Celsius by 2025 and 2100, respectively. In tropical and subtropical region wheat yield can be reduced by 3% to 20% with rise of each degree in ambient temperatures (Lobell *et al*., 2008), (Mondal *et al.,* 2013) & (Lal *et al.,* 1998). HS has affected 36 million acres of land worldwide, with the majority of this land in South Asia (Reynolds *et al.,* 2001). In India the total area of wheat which got affected by heat stress is 13.5 million hectares (Joshi *et al.,*2007). The crop season may be altered as a result of rising temperature, due to which the crop may mature early (Porter 2005; Gupta *et al*., 2013).

Drought is a long period of time with less or no water availability, like with no rain or unusual low levels of rain. On the other hand, we can define drought tolerance as the plant's capability to get the plant growth, to stay alive, and for proper reproduction with less water availability or under periodic water shortage situations (Turner, 1979). Tolerance of drought is a measurable characteristic which can be influenced by phenotype and genetics (McWilliam, 1989).

In majority of cultivated areas "drought is one of the most crucial variables affecting yield reduction". According to Trethowan and Pfeiffer study the area affected by drought is different for developing and developed countries, like in developing countries 50% area under wheat production got affected whereas in case of developed countries 70% of area under wheat production got affected by drought (Trethowan and Pfeiffer, 2000). There are different ways how plants respond to drought like in case of Cereal plants drought causes changes in morphological, physiological, and metabolic properties, as a result there are a variety of characteristics linked to improved performance in water-stressed environments or improved survival in severely low water availability (Slafer *et al.,* 2005). It is noted that drought affect many things like plant growth, its production, membrane integrity, adjustment for osmosis, pigment content, water relations, and the photosynthetic activity (Praba *et al.,* 2009). Grain yield and yield components are complicated characteristics which are impacted by factors of environment and are differentiated by low heritability & strong genotype interactions in environment under the drought situations, making advancement difficult (Smith *et al.,* 1990).

Different researchers stated different effects of heat stress on plants like heat stress which can reduce the capacity of photosynthesis (Almeselmani et al.,2012) and (Ashraf and Harris,2013). Some researcher said that heat stress can cause the change in water relations of the plant (Hasanuzzaman et al., 2012; 2013). Hormonal changes can be occurred by heat stress (Krasensky and Jonak, 2012). HS can lead to reduction of activities occurring metabolically (Farooq et al., 2011), and synthesis of reactive oxygen species (Wang et al., 2011; 2012; 2014; 2016), HS can cause increase in pollen mortality, promoting the production of ethylene in wheat and reduce the development of pollen tube (Oshino et al., 2011).Under terminal heat stress, many of the characteristics that contribute to heat tolerance are heritable, additive, and variable, indicating the potential for improvement of wheat (Tuberosa and Salvi, 2006).

Heat tolerance is one of the complicated phenomena which is governed by a number of the genes that regulate several biochemical and physiological traits. Molecular markers are the better way to analyze on the basis of genetic thermotolerance (Maestri *et al.,*2002). As there is difficulty in selection of phenotypes for the plants tolerant to heat and drought and in the general complexity of abiotic stress tolerance, as a beneficial strategy, marker assisted resistance had been proposed as to create the crop resistance of stress. MAS requires the recognition of markers used genetically and those who were linked with the Quantitative trait loci (QTLs) that alter total stress tolerance capacity of plant or some components which contribute individually. Analysis of QTL basically based upon the high-density molecular linkage maps, and it is a useful method for dissecting genetic foundation behind complex phenotypes into discrete components.

Regression analysis revealed significant association of differences in TGW between optimum and late sown of RILs with two markers, viz. Xpsp3094 and Xgwm282 with coefficients of determination (R2) values of 0.14 and 0.11, respectively. It could explain the variation in the phenotypes of RILs. The R2 values suggested that the Xpsp3094 and Xgwm282 accounted for 14% and 11% of the total phenotypic variation in heat tolerance in the RILs population, respectively (Pandey *et al.,* 2014). The highest mean number of alleles was detected in the B genome (2.6) followed by A genome (2.25) and D genome (2.1) (Sheoran *et al.,* 2015).

Field based study gives better opportunity to investigate terminal heat tolerance in wheat. Late sowing (LS) gives an opportunity to evaluate the genotypes for their adaptability to higher temperature as under late sowing the crop receives gradual increase in temperature right from early growth stage until maturity, which is diferent than sudden spurt in temperature coming as a shock to the normal timely sown growing crop (Pandey et al., 2019).

Here we will mainly study about the physiological traits of wheat at high temperatures and with less water availability at different stages and then we will try to find that how to exploit this problem to improve the yield and productivity of plant.

2. Heat stress and Drought associated physiological traits

Physiological traits are the physical traits of an individual, and in case of plants we can describe them as the hormones and other growth regulators which are produced by plants and function as signals in their tissues to convey a physiological response.

There are so many kinds of physiological traits linked with heat tolerance of wheat mentioned below: -

2.1. Leaf senescence

During leaf senescence some structural changes takes place in the chloroplast which include vacuolar collapse, cellular homeostasis, and loss of integrity in plasma membrane (Lim *et al.,* 2007; Khanna and Chopra, 2012). If plants are exposed to extreme heat stress throughout their maturation, leaf senescence is accelerated. (Haque et al., 2014). Stay green genotypes delays the expression of senescence-related genes so that it can preserve the photosynthesis (Lim *et al.,* 2007).

In their research Vijayalakshmi and her team find that while staying green is regarded as a stress-response mechanism and chlorosis act as an important aspect of planned senescence, where there were tradeoffs in between photosynthesis retained area and nitrogen remobilization of the developing grain (Vijayalakshmi *et al.,* 2010). In mapping populations, QTLs for the relationship between staying green and yielding have been discovered (Kumar *et al.,* 2010), (Vijayalakshmi *et al.,* 2010). As chlorosis manifests itself differently in all above ground organs, it is quite difficult to regard this within a single organ, like a leaf. However, simple and integrated ways to assessing spectral reflectance remain green. In two large mapping populations under heat stress, the Normalized Difference Vegetation Index (NDVI) explains a notable association with yield, enabling it a reliable tool for screening at large scale and gene discovery activity (Lopes and Reynolds, 2012). While NDVI is linked to heat tolerance, it is a reliable metric of greenness that takes into account all chlorophyll. Wheat leaf senescence can be accelerated by inhibiting chlorophyll production under high temperatures (>34°C) (Asseng *et al.,* 2013). Heat stress mainly impact photosynthesis, causing pre-mature senescence of leaf, reduced leaf area growth, and eventually lower yield (Lukac M. *et al.,* 2014), (Feng *et al.,* 2014). Heat stress delaying can initiate senescence of leaf, grain yield can be improved by spraying potassium orthophosphate (KH2 PO4) on the leaves following anthesis (Dias and Lidon, 2010).

2.2. Fertility of spike

Sets of grain appears to be cautious and sensitive to carbohydrate availability even under somewhat ideal conditions (Fischer, 2011). Hot wheat-growing data settings demonstrate that number of grains is frequently lowered much than it would be predicted due to biomass decreases, resulting in a decrease of heat index under heat stress (Reynolds *et al.,* 2007). Grain reduction is caused by programmed cell death at high temperatures produced by ethylene levels (Hays *et al.,* 2007). When meiosis and abiotic stress occurs at the same time, the initial step of gamete formation may be harmed even more (Ji *et al.,* 2010). Wheat plants subjected to be at 30°C during 3-day period around anthesis had aberrant anthers in 80 percent of the florets, both physically and functionally. If we observe the growth rate of pollen tube,

HS can impact chemical content, its metabolism, shape, and pollens quantity (Hedhly *et al.,* 2009). Carbohydrate metabolism has been associated to lower pollen viability in other cereals, such as sorghum under stress due heat stress (Jain *et al.,*2007), (Prasad and Djanaguiraman, 2011). It is evident that HS damage female reproductive organs, despite the fact that this has received less attention. When HS coincided with meiosis, abnormal ovary development occurs, as well as rapid stigma and ovule developed, which results in lower the growth of pollen tube and sets of seeds (Barnabas *et al.,* 2008). In wheat for hot settings, grain number QTLs have been discovered, and most of these have been shown to match with the yield QTLs (Pinto RS *et al.,* 2010). So, these interactions needed to be clarified and in wheat gene pools for spike fertility genetic diversity at extreme temperature has to be investigated.

2.3. Starch Synthesis

When assimilates are present, temperatures which lie between 30°C-40°C can inhibit accumulation of the starch in wheat grains about 30%, with early grain filling being the most significant stage (Stone and Nicolas, 1995). In starch accumulation, the enzymes involved are a promising target for improved climate adaptability. Enzymes like AGPase, starch synthase bounded to granule, soluble starch synthase, enzyme which can branch starch, enzyme which can debranched starch, and plastidial starch phosphorylase are the most important enzymes. Cereal endosperm has a distinct starch production pathway that necessitates the presence of (1) cytosolic AGPase (2) ADP-Glc transport (Geigenberger, 2011). In 2011 According to Liu and his colleague it was stated that heat-shock treatment for temperatures lie over 30°C can results in a notable decrease in the amount of starch in grains of wheat (Liu *et al.,* 2011). At 40°C, roughly 97 percent of activity was off track because of small quantity of soluble starch synthase present, and as a result, starch accumulation and size of grains in wheat were decreased (Chauhan *et al.,*2011). Heat stress inhibits starch production in grains of wheat, while causing a considerable raise in number of total protein and soluble sugar (Asthir and Bhatia, 2014). At the seedling stage stress due to increased temperature will decreases soluble sugar content and the biomass (Wang *etal.,* 2014).

2.4. Canopy Temperature (CT)

Temperature of canopy is closely linked to the formation under stress of drought & heat, and both the situations seems to share a same genetic base (Pinto RS *et al.,* 2010). Lopes and Reynolds stated in 2010 that Recent research suggests that during drought and heat stress, canopy temperature is linked to deeper roots (Lopes and Reynolds, 2010). While the cooler canopy is connected to genetic variance in stomatal conductance under heat, canopy temperature selection can aid the enhancement of heat tolerance (Reynolds *et al.,*1994; 2007).

2.5. Membrane thermostability

Membrane is regarded as an important location of the physiological harm caused by heat, despite the fact that resistance to high temperatures requires multiple complicated tolerance and avoidance processes (Blum, 1988) and membranes damage can be analyzed by calculating solute leakage from tissue. In 1998 it has been found that Thermostability of membranes is a heritable trait (Fokar *et al.,* 1998). Heat shock will form denaturation in proteins and increases unsaturation of fatty acids which later impair water, ions, and migration of organic solute across the membranes, impeding cellular activity. "In plants swelling there are some common features of thylakoid membranes such as physical separation of the chlorophyll light harvesting complex II from the PSII core complex and this increase leakiness and disruption of PSII-mediated electron transport" (Ristic *et al.,* 2008).

2.6. Chlorophyll fluorescence and Chlorophyll content

In field, phenotype after Canopy temperature and Chlorophyll content, the another most commonly utilized characteristics is Chlorophyll fluorescence (CFL). For selecting the heat and drought resistant wheat genotypes, the importance of chlorophyll fluorescence (CFL) in grain productivity under conditions of water stress has been advised. CFL is directly results in production, that is genotypes with larger yield will have high CFL value, implying that CFL may be used to screen for tolerant genotypes. In genotypes of wheat CFL can determine photosynthetic efficiency indirectly. For the characteristics of CFL, Chl and TGW analysis on RIL mapped populations was calculated by a cross of the genotypes of heat sensitivity and the the genotypes of heat tolerance which evident that 17 RILs out of 112 were exhibited and heat susceptibility index (HSI) for all the characteristics was less than 1. For heat and drought tolerance plant selection of wheat plants, the function of CFL &Chl in connection with grain production under

water stress has been suggested (Blum 1988, 1989) and (Krause and Weis, 1991). Quarrie and his team in 2005 said that in wheat near-isogenic lines (NILs), Chl present around flowering time was positively related with its yield (Quarrie*et al.,*2005). In 2008 Wang and team reported that maintaining a greater Chl level in wheat plant is an efficient way to boost yield and biomass (Wang et al.,2008)

2.7. Water relations

There are many factors which can influence the plant water relations such as the content of water, relative water content, rate of water loss, succulence index, excised leaf water retention, and transpiration rate residue. Relative water content (RWC) is the most important metric for dehydration tolerance and it measures status of plant water that reflects metabolic activity in tissues. For drought stress a drop in RWC has been seen as a response in wide range of plants (Allahverdiyev *et al.,* 2015). Clarke and Thomas reported in 1982 that when we compare completely hydrated leaves to those which are under watering deficit, changes in excised leaf water loss may be used as to evaluate the relations of plant's leaf, and it's an indirect way to measure of Cuticular thickness and transpiration (John and Thomas, 1982). This characteristic represents the balance between rate of transpiration and water supply of leaf. For more drought resistance reduced excised leaf water loss genotypes are considered better as it is less impacted by water losses occurring via evapotranspiration and due to which it's able to retain water (Izanloo *et al.,* 2008). Dehydration tolerance are linked to different antioxidants and these are activated as a response to heat stress,and this occur because of increase in transpiration and reduce in osmotic potential in the stressed leaves (Ahmad *et al.,* 2010) Due to a raise in aquaporin activity heat stress enhances the cell membranes hydraulic conductivity and the plant tissues (Martinez *et al.,* 2009)and to a larger level when there is less viscosity in the water (Cochard*et al.,* 2007).

2.8. Osmotic Balance

Drought tolerance processes help the cells to control dehydration and to maintain integrity of membrane structure such as osmolyte accumulation which allowing them to withstand drought and dehydration in cells (Loutfy N *et al.,* 2012). Storage of organic solutes having low molecular weight may cause osmotic adjustment in drought-stricken plants. In order to maintain osmotic balance, water uptake and water retention, plants will accumulate and create some suitable solutes like amino acids, sugars and polyols as in response to drought stress (Hussain H.A. *et al.,* 2018).Sugars, much more than proline, become a crucial alternative for water in acute dehydration which results in forming a shell of hydration around the proteins (Bowne *et al.,* 2012). Under drought stress, throughout the grain filling period the genotypes of wheat will collect more soluble carbohydrates than during the pre-anthesis stage (Farshadfar *et al.,* 2008). The ROS production under drought stress resulted in amino acids oxidation, which might rupture the protein structure. However, a substantial link was found between total proteins and wheat grain production under rain-fed circumstances (Farshadfar *et al.,* 2008).

2.9. Hormonal effect

There is various type of plant hormones but in 2007 according to Thompson Drought adaptation can be influenced by abscisic acid production in two ways: avoidance of dehydration and tolerance of dehydration (Thompson A.J *et al.,* 2007) and later Lata C. and Prasad M. in 2011 said that in controlling the abiotic stimuli tolerance such as drought, salinity, cold, heat, and wounding in all the main role plays by abscisic acid (Lata and Prasad, 2011). Abscisic acid (ABA) has been recognized a chemical signal from root to shoot (Schachtman and Goodger, 2008), inhibiting leaf growth and triggering short-term responses such as stomatal closure. Before there will be any apparent changes in water or nutritional status of leaf, ABA is engaged in control of abiotic stress systemic response (Suzuki *et al.,* 2013). Furthermore, in wheat under drought stress yield has a strong link with ABA which has been discovered as a promotor to operate the root development (Xu *et al.*, 2013). There are several additional growth regulators such as auxin, cytokinin, gibberellins, brassinosteroids, jasmonic acid, ethylene, and other variables like nitrogen, pH are synthesized or catabolized as osmotic stress response (Lamaoui *et al.,* 2018).According to previous research, ABA is produced in xylem tissues during droughts and subsequently alter grain filling by influencing the gene expression which is involved in metabolism of glucose and division of cell it will transferred to reproductive organs. Drought causes raise in accumulation of ABA content in leaves, stems, and root exudates but it also brings decrease in leaf cytokinin

levels (Yang J. *et al.,* 2004). The grain filling rate under mild drought was boosted by lower ethylene, also by the concentration of 1-aminocyclopropane-1-carboxylic acid and with the higher concentrations of ABA in growing grains of wheat. However, when there was a severe drought, the levels of ethylene and ABA were excessively high and this lowering the grain filling rate (Yang D.L *et al*., 2007).

2.10. Oxidative Damage

2.10.1. Reactive Oxygen Species (ROS)

The plants which are heat and drought exposed usually results in ROS production which is very harmful such as singlet oxygen molecule, superoxide radical, hydrogen peroxide, and hydroxyl radical (OH), all of these are oxidative stress responsible (Marutani*et al.,* 2012), (Suzuki *et al*., 2012). The presence of ROS will cause oxidation of the pigment present photosynthetically, oxidation of membrane lipids, oxidation of proteins and nucleic acids which results cell death and diminished the growth of plant and productivity (Hasanuzzaman M. *et al.,* 2018). On the other side the negative impacts of drought stress are determined by the length, timing, and amount of the stress (Hasanuzzaman M. *et al.,* 2018). Peroxidation of membrane and organelle, activation or inactivation of enzyme, and nucleic acid destruction are caused due to the amount of water stress and it is proportional to the amount of ROS produced (Outoukarte I. *et al.,* 2019).The presence of malonic dialdehyde (MDA) has long been thought to be a good indicator of membrane degradation. According to a prior study, the degree of lipid peroxidation produced by ROS is reflected in membrane stability (Sharma P. *et al.,* 2017). Drought stress tolerance in wheat plant was linked to low MDA levels (Zhang Y. *et al.,* 2011). It is notable that the oxidation of polyunsaturated fatty acids enhanced by the lipoxygenase enzyme activity (LOX) and it is responsible to increase lipid peroxidation in stress situations (Sanchez-Rodriguez E.*et al.,* 2010).Drought stressed plants accumulate LOX activities differently than non-stressed plants (Alam M. *et al.,* 2013).Activity of raised LOX and oxidative stress were shown to have a comparable association (Sanchez-Rodriguez E. *et al.,* 2010).More raised lipid peroxidation and Reactive oxygen species (ROS) weaken the cell activities in membrane and it results into the loss of membranes capacity to control the ion transport in and out of cells which commonly employed as a tissue damage test. More metabolite or ion leakage indicates a more disfigured membrane caused due to drought sensitivity. According to Savicka M and Skute N in 2010 (Savicka M and Skute N, 2010).

2.11. Photosynthesis and Gaseous Exchange

Photosynthesis is a process which is essential for the growth of plant and also for the grain yield; So, for understanding the role of plant response based on physiology for both that is drought and heat is critical. In plants to determine the degree of photosynthesis which are growing under water stress the fundamental signal is variation in the concentration of photosynthetic pigment. Drought rate is inversely proportional to photosynthetic rate of cereals that means in cereals photosynthetic rate is reduced because of drought (Dawood *et al.,* 2019). In 2015 Pandey V. and Shukla A. reported that Carbon dioxide diffusional limitations are occurring as stomata closes itself earlier as response to the drought induced turgor loss, the photosynthetic enzyme reduced its activity, biochemical components related to triose-phosphate formation, and decreased photochemical efficiency of photosystem II are the major factors limiting photosynthetic rate (Pandey V. and Shukla A., 2015).

Although if we compare the limitations of the photosynthesis than the limitations of drought induced via metabolic distortions are very complicated than limitations of stomata, which caused mostly by decreased production of photosynthetic pigments (Rama R. *et al.,* 2014). In response to drought the mesophyll conductance and stomatal conductance to CO2 will decrease (Centritto M *et al.,* 2009). The loss in photosynthesis caused by lower expansion of leaf surface area, impaired machinery of photosynthesis, pre-maturation which brings leaf senescence early, and concomitant decrease in the yield of wheat is a key impact of heat stress (Ashraf and Harris, 2013; Mathuret *al.,* 2014).

3. Breeding for heat and drought tolerance

Several types of traits mentioned above are some good topics for the research, whereas some of them have already been applies for in the breeding of heat tolerance. Such as the cooler temperature of canopy seems to have similar genetic basis under both the stress that is stress caused by heat and drought (Pinto RS *et al.,* 2010) and in both environments with yield these are strongly associated.

Lopes and Reynolds in 2010 said that Under drought canopy temperature is associated with roots present at deeper site (Lopes and Reynolds, 2010) and also in heat stress (Unpublished data of M.P. Reynolds). In the stomatal conductance which under heat, the cooler canopies will be associated with genetic variation in the stomatal conductance (Reynolds *et al.,* 1994) and (Reynolds *et al.,* 2007).

There are many ways to raise the assimilation capacity such as candidate's parent screening as to improve the light interception (LI) delayed senescence, photoprotective pigments and the wax for the improvement of RUE, Other approaches like Rubisco and its regulations photosynthesis of spike are another long-term target with potential high payoffs.

Yield gains are dependent on the crop's ability to create partition in the assimilates of the grain. As RUE and LI are adjusted, production improvements will become more dependent on the crop's capacity to partition assimilates for the grain. For reproductive growth adaption to HS improved knowledge includes plant growth regulators interactions (Hays DB *et al.,* 2007). If genetic advancements in absorption ability are to be converted into the agronomic yield via prolonged expression of the heat index, a lot of work will be necessary. In this regard, capacity for the storage of WSC and the remobilization are the two main qualities that may help to preserve heat index by buffering the supply of assimilates against highly changing weather.MAS is recognized as a better technique because of the total complexity of tolerance in abiotic stress and the challenges in the selection of phenotypes. However, only a few attempts had been undertaken to uncover the genetic markers which were related to the heat tolerance in several plants, including wheat. As a result, we can say that the genetic components underpinning the heat tolerance and to discover the accurate molecular marker used in molecular breeding to increase wheat grain production.

Several forms of abiotic stress in crop plants can bring challenge, including high temperature, more irradiance, shortages of water are occurring and shortfalls of nutrients and all of these are common under normal growth conditions but may not be managed with regular agricultural operation. Marker identification and the identification of genes are linked to the development of root and its structure would be much valuable for the breeding programmes utilizing molecular marker aided choices to improve root attributes.

4. Conclusion and Future prospects

The increasing global temperature also raise the frequency of heat stress and this ultimately leads to the less production of grain yield. We can minimize heat and drought stress effect as by developing the tolerant genotypes and agronomic strategies. In case of wheat physiological basis of heat tolerance assimilates partitioning is also essential. Drought stress activates ABA signaling which proceeds to the closure of stomata and then decreased the carbon dioxide influx and start regenerating ROS and create oxidative stress because of which damage of protein and lipids takes place and furthermore it leads to the cell death. To overcome from this antioxidant defense system is better approach to diminish oxidative stress and it's the most effective strategies to make drought tolerant wheat plant. By the use of functional genomic approaches, we can explore the molecular basis of mechanism of response and tolerance, which were used to garnering the higher yields on basis of sustainability so this is how we can make crop resistance against heat stress and drought. For future prospects, the area on which we can research includes the conventional breeding blended with new tools of biotechnology for identification and the introgression of gene used for heat tolerance and drought tolerant into the elite lines. Combination of ecophysiological research and recent genomics helps in understanding the genotypes and the interactions of environment and under stress some integrated system should be designed for wheat stability of yield.

Conflict of Interest: - The authors declare that there is no conflict of interest.

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