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PRE-DISSERTATION

SYNOPSIS

Submitted by:

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(11718744)

In partial fulfillment for the award of the degree
of
Masters of Science in Agriculture
(Genetics and Plant Breeding)

Under Guidance of
Dr.Anant Madakemohekar
(Assistant Professor)

Discipline of Agriculture
Lovely Professional University, Phagwara, Punjab
Jalandhar144402 India

May2018

CERTIFICATE

This is to certify that the project entitled study **Effect of Heat stress on stem reserve remobilization on Advance line of Bread wheat (*Triticum aestivum)"*** is going to be done by Ankit Kumar (11718744), as per the research work (dissertation program) GPB 591 in partial fulfillmentfor the award of the degree of Masters Of Science in Agriculture (Genetics & Plant Breeding)from Lovely Professional University, Phagwara,(Punjab) 144402 India .. under the guidance of supervisor.

Dr. Anant madakermohekar

(Assistant Professor)

Lovely Professional University, Phagwara

DECLARATION

Certified that this report is an overview of practical work which I am going to perform.It is my individual research project entitled "**Effect of heat stress on stem reserve remobilizationin on Advance line of bread wheat (*Triticum*aestivum)**". It is going to complete during the academic period 2017-2019 of M.Sc. Agriculture (Genetics & Plant Breeding) course, supervising by Dr. Anant Madakemohekar, Assistant Professor, LPU, Phagwara and Dr. Uttam Kumar, Wheat Breeder, BISA, Ludhiana.

I declare that this project will be done atLPU, Jalandhar and BISA, Ludhiana and it shall not be submit to any other University for the award of any degree.

Ankit Kumar (11718744)

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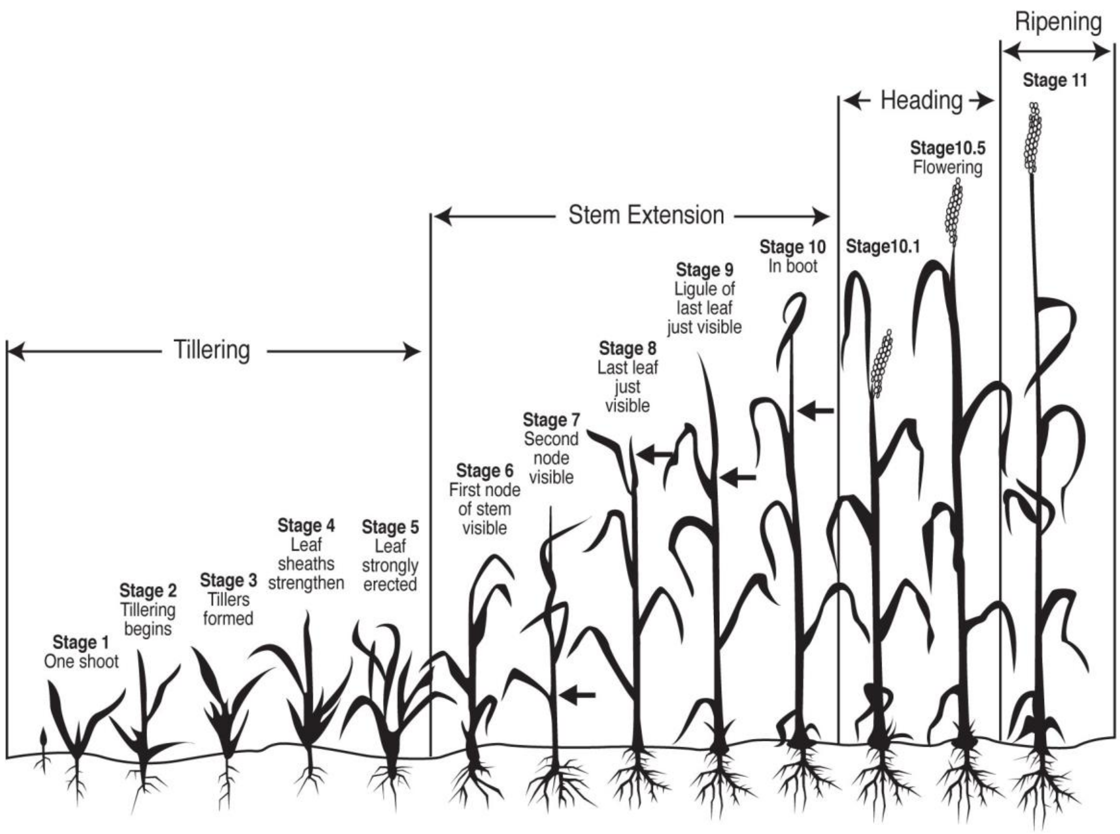
Introduction:

Wheat belongs to grass family Poaceae and second important cereal crop in India. It is staple food crop for most of the human being around the world.In Asia, wheat is consumed predominately in the form of bread or chapatti thrice a day. Wheat is source of nearly 19.5% protein providing 20% of calories. Bread wheat (*Triticumaestivum*) is naturally allopolyploid consists 3 genomes (AA, BB and DD) making is as hexaploid (2n=6x=42). Wheat is originated in middle Asia (Turkey) and currently grown at nearly 225 mha in the world. The total wheat production is approximately 760 mt which is second largest after maize.

In term of nutrition value, wheat grain contains 70% carbohydrate, 2.2% fiber, 12% protein, 1.8% minerals, 2.2% fat, 12% water and other important compounds like Thiamine, Riboflavin, Niacin and Vitamin A. The wheat nutrition value get affected by multiple factors including biotic and abiotic stresses, soil fertility, management and environment. The heat and drought not only affect the grain quality but the yield also. Under severe drought and heat, the wheat yield may be reduced 50-90% of their yield potential depending on the amount of severity [A Aprile,AMD Leonardis 2009]. On farm studies indicated that nearly 60 mha are is affected by drought in developing countries which is expected to increase more due to climate change[MP Reynolds, AM Kazi and M Sawkins].

The wheat life cycle is passed through six different critical growth stages like crown root initiation (CRI), tillering, booting, flowering, milking and grain filling (Pic 1). The grain filling is critical not only for drought but for terminal heat stress. The heat stress tolerant lines theoretically able to translocate the stem reserve to grain efficiently and minimizing heat stress effect. In wheat, high temperatures (>30 ^{0}C) after anthesis can decrease the rate of grain-filling (Stone and Nicolas 1995), while high temperatures imposed before anthesis can also decrease grain yield. Yields are reduced 3–4% per 1^{0}C rise above the optimum temperature (15–20 ^{0}C) during grain filling (Wardlaw et al. 1989). Using this factor (3–4% loss per 1 ^{0}C above 15–20 ^{0}C), it can be calculated that most commercially-sown wheat cultivars in India would lose approximately 50% of their yield potential when exposed to 32–38 ^{0}C temperature at the crucial grain formation stage. It has been observed that a heat wave (35-37 ^{0}C) of 3-4 days modifiesgrain morphology and reduces grain size (Wardlaw and Wrigley 1994). For example, a short period (4 days) of exposure to high temperature (>35 ^{0}C) reduced grain yield up to 23% (Stone and Nicolas 1994)and three days heat treatment (~38 ^{0}C from 08:00 to 17:00 hours) reduced individual yield component up to 28.3% (Mason et al. 2010). The higher temperature during entire crop cycle reduce the crop duration.

Remobilization of stored carbohydrate reserve in wheat is accelerated by water stress and the water deficient impose during grain filling enhance plant senescence and effect grain filling period and reduction in grain weight (Yang et al 2001). Effect of drought stress and natural senescence reduce the rate of photosynthesis at terminal stage,whereas at this stage,to increase kernel size, the photosynthesis rate need to be enhanced.In this situation,stem reserve play a vital source for grain filling and wheat crop in heat stressed area may depend more on stem reserve than on current photosynthesis for proper gain filling (Ehadaie et al 2006). A better stem reserve and its remobilization have been considered as a heat and drought adaptive trait in wheat (Reynolds et al 1999).



Objective:

The main objective is evaluate advanced wheat breeding lines in India under heat stress environment and study the effect of genotypes on stem reserve remobilization to develop heat tolerant lines.

Review of literature:

- **Abbas et.al. (2017)** studied dry matter accumulation and remobilization in wheat cultivars under drought conditions.The experiment was carried out using a split plot factorial based on a randomized complete blocks design with three replications. The experimental treatments included three irrigation regimes; normal, mild stress (water withhold at the seed filling phase) and severe stress (water withhold at the ear emergence phase).
- **Arnauld et.al. (2016)**evaluate different genotypes of wheat and studied the screening methods for abiotic stress related to productivity. The method quantifies the components

of a new index related to yield under abiotic stress based on previously developed stress indices, namely the stress susceptibility index, the stress tolerance index, the mean production index, the geometric mean production index, and the tolerance index, which were created originally to evaluate drought adaptation.

- Bl**um (2015)** evaluate the wheat genotypes for the genetic improvement of stem reserve storage and utilisation as a potent mechanism for grain filling under stress is discussed, and practical guidelines for selection work.
- **Fathi (2006)** worked on grain yield and protein in wheat genotypes and examined the interaction between post- anthesis water stress and nitrogen rate in six wheat cultivars.
- **Monneveux et.al. (2012)** assessed phenotyping for drought adaptation in wheat using physiological traits.He said that further progress in developing drought tolerant germplasm depends on the efficiency of breeding and phenotyping methodologies.

Method and Methodology :

The present work will be done at LPU, Phagwara and BISA Ludhiana. Data analysis and thesis writing will be done at LUP while field experiment and data collection will be done at BISA Ludhiana during Rabi season.

Agronomical , phonological, and physiological trait in drought condition in field as well as in green house for increase wheat yield and income of farmer in dryland area and selection of wheat genotype for future farming under global warming condition.

A total of 10 high yielding lines will be selected from CIMMYT wheat breeding program. The lines will be planted in two replications in two dates. The first sowing date will be normal sown (First or second week of November) and the second date will be late sown (Last week of December or first week of January). The late sown will be used as exposure to heat stress.

Data will be recorded on phenological, agronomical and physiological traits as mentioned below:

Days of booting: When main tiller of 50% plant in the plot show swollen steam,the day will marked and day to booting.

Days to heading: When half of ear will be emerged in 50% plant in plot the date will be marked as day to heading.

Days to anthesis: When 50% head of main plot show anther emerged from spike will be marked as day to anthesis.

Days to physiological maturity: When 50% peduncles in a plot turned yellow, the date will be marked as days to physiological maturity.

Plant height: The height of plant from ground to the top of ear excluding awns recorded in centimeter.

Spike length: Length of spike in centimetre excluding awns.

Leaf length: The leaf length will be recorded from the leaf base to the tip of leaf in centimeter

Leaf width: The leaf will be folded to half and the width will be recorded from the middle of leaf in centimeter.

Number of tillers per plant: Total number of tiller from 10 randomly selected plants will be recorded from each plot.

Harvest index (HI): The total plot yield will be divided by the total dry biomass to calculate harvest index.

Yield (t/ha): The total plot yield will be used to calculate yield t/ha based on the total plot area.

Thousand grain weight: One thousand grain from each plot will be counted manually or with the help of seed counter.

Physiological traits:

Partitioning of photosynthates: 25 random plants will be harvested from each plot three times at three different growth stages (Booting, heading and physiological maturity). The fresh biomass will be taken immediately after each harvest from each plot. After weighing, the samples will be dried in the hot air drier. Once the dry weight is stabilized, the dry weight of each sample will be recorded.

Biomass accumulation pattern: The same data recorded above will be used to seed the biomass accumulation pattern of each genotype under heat stress environment.

In addition to the traits mentioned above, the canopy temperature (CT) and NDVI of each plot will also be recorded at different time interval for correlation studies. The CT will be recorded with hand held infra-red thermometer while the NDVI will be recorded with hand held green seeker (Trimble Co.). Data will be recorded at booting, heading and physiological maturity.

Effet of drought stress on moisture content of internode :

Calculating the effct of drought on moisture content of internode because this part are highly responsible for remobilization for grain filling .

Defoliation treatment :

Defoliation treatment removal of(flag leaf and penultimate leaf from stem) will be applied to five tagged tiller from different plant with uniform height and spike size before onset of anthesis . Another five tiller were tagged and but not defoliated , which will be use for control for the expirement . At

maturity all the tiller will be separately harvested . stem reserve estimated based on percent reduction of thousand grain weight for each line .
Percent reduction in kernel weight by defoliation treatment was obtain by compairing mean kernel weight by defoliation treatment was obtain by compairing mean kernel weight under defoliation with mean kernel weight in control , for each tested genotype(Blum ,1998) for remobilize

Stem Reserve Mobilization:

Stem reserve mobilization was calculated by the method suggested by Cox et al (1986). Five stem (penultimate and penducle without spike) from randomely selected plant from each plot at anthesis and maturity were seprated into penultimate and penducle and dry in an oven at 80 degree celcius for 72 hrs . The weight of stem part was recorded with analytical balance (Afcost ,ER 200A) and stem reserve mobilization was calculated using following formula .

SRM (%) = DMSHT (Ant) – DMSHT (Mat) / DMSHT (Mat) .100

SRM = Stem Reserve Mobilization (g/Plant)

DMSHT(Ant) = Above ground dry matter of stem part at anthesis stage (g)

DMSHT(Mat) = Above ground dry matter of stem part at Maturity stage (g)

SRM from stem part (penultimate and penducle) was calculated separately .

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Crop management:

Agronomic practices recommended for normal fertility (120 kg N: 60 kg P2O5: 40 kg K2O) will be followed. The full dose of P_2O_5 and K_2O will be applied at the time of sowing. Nitrogen will be given as split application; 1/2 at sowing, 1/4 at first irrigation (21 days after sowing), and 1/4 at the time of second irrigation (40 days after sowing). To minimize the confounding effect of drought, all six irrigations will be given at different growth stages or if required.

Data analysis:

The data will be analysed using Meta-R statistical software developed by CIMMYT. The Meta-R is windows based statistical software where R-statistical package works in background.

Result interpretation and write up: Once the data is analysed, the results will be interpreted and summarized.

Expected outcomes:

The stem reserve mobilization under heat stress is poorly understood and has not been explored in detail. Therefore, understanding of agro-morphological traits and the traits adapted to heat stress tolerance will be enhanced. The genotypes efficient for stem reserve remobilization under heat stress will be used for breeding program to develop heat tolerant lines.

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