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Quantitative Changes in Primary Metabolites in Barley (*Hordeum Vulgare L.*) Due to Stripe Disease, Causal Agent Drechslera Graminea

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Abstract- Quantitative studies of primary metabolites were conducted on healthy (control) and naturally infected (weakly, moderately and heavily) with *Drechslera graminea*, seeds and seedlings of Barley at different stages after sowing. Observations revealed that content of total sugars were highest in healthy (control) seeds and lowest in heavily infected seeds and were continuously increased in healthy (control), weakly and in moderately infected seedlings and decreased in heavily infected seedlings from 10 to 30 days after sowing. Total starch contents were also highest in healthy (control) and lowest in heavily infected seeds. Starch contents were slightly increased up to the 20 days and followed by deceased to the 30 days after sowing in all categories of naturally infected. Phenols and proteins decreased as the severity of infection increased and were highest in weakly infected and lowest in heavily infected seeds among naturally infected seeds. Total phenol contents were increased throughout from 10 to 30 days after germination. Proteins showed same response as phenols.

Index Terms- Quantitative changes, Primary Metabolites, Barley, Stripe disease and *Drechslera graminea*

I. Introduction

Barley (*Hordeum vulgare* L.), a member of the grass family, is a major cereal grain. *H. vulgare*, the fourth important world crop, used for animal feed, beer, and human food was domesticated polyphyletically by humans 10,000 years ago in the Neolithic revolution in at least three centers[1]. Stripe disease is a major disease in our country causing losses as high as 70 to 72 per cent under epiphytotic conditions[2]. *Drechslera graminea* (Rabenh. ex Schlecht.) Shoemaker (sexual *Pyrenophora graminea*) is the causal agent of barley stripe. Barley stripe is disease of barley that once caused significant crop yield losses in many areas of the world. The fungus is present in the seed coat and on the seed surface. As seedlings start to grow, the fungus invades the coleoptile, penetrating to the first leaf. During infection the host plant defend itself against potential pathogens by means of number of physical and chemical factors which may already present in the host, or may be produced in response to the infection[3]

II. MATERIAL AND METHOD

Seeds and seedlings of healthy (control) and naturally infected (three categories weakly, moderately and heavily) with *Drechslera graminea* after 10, 20 and 30 days of sowing were taken for conducting studies. The seeds were grown in petriplates on blotter and earthen pots (height 30 cm, diameter 20 cm) filled with sterile coarse sand (pH 8.3). The emerging healthy and naturally infected seedlings were excised for the estimation of primary metabolites at 10, 20 and 30 days after sowing.

Estimation of primary metabolites: Total sugars and starch were estimated by the method of Dubois *et al* [4]. Total phenols were determined by Swain and Hills's method [5] and total proteins were measured according Lowry *et al* [6].

III. STATISTICAL DATA ANALYSIS

All experiments were performed in 3 different sets with each set in triplicates. The data are expressed as mean, ± SEM (standard error of the mean). Statistical analysis of data was done by using BioStat 2009 professional 5.8.4 software in a completely randomized design. All data obtained by subjected to one way analysis of variance (ANOVA). Values of p which were ≤ 0.05 were considered as significant. Graphs were drawn by using Microsoft Excel software

IV. RESULT

Total sugar contents were highest in healthy (control) and lowest in heavily infected among all three categories of naturally infected seeds. Sugars were continuously increased in healthy, weakly and in moderately infected seedlings and decreased in heavily infected seedlings from 10 to 30 days after sowing.

Total starch contents were also highest in healthy (control) and lowest in heavily infected seeds. In all three categories of naturally infected (weakly, moderately and heavily) starch contents were slightly increased up to the 20 days and followed by deceased to the 30 days stage after sowing.

Proteins were decreased as the severity of infection increased in seeds. In seedlings, protein contents were continuously increased in healthy, weakly and heavily infected seedlings throughtout from 10 to 30 days after sowing except in moderately infected seedlings.

Phenols showed same response to infection as protein and decreased as the severity of infection increased. Phenols were highest in weakly infected and lowest in heavily infected seeds. Total phenol contents were increased in weakly, moderately and heavily infected seedlings from 10 to 30 days after sowing.

All experiments were performed in triplicates. One way analysis of variance (ANOVA) was used to show significance of

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difference with respect to control. In all experiments ρ value was found to be lower than 0.05 (ρ <.05) which indicate that differences in seedlings of different categories and of different time intervals was statically significant.

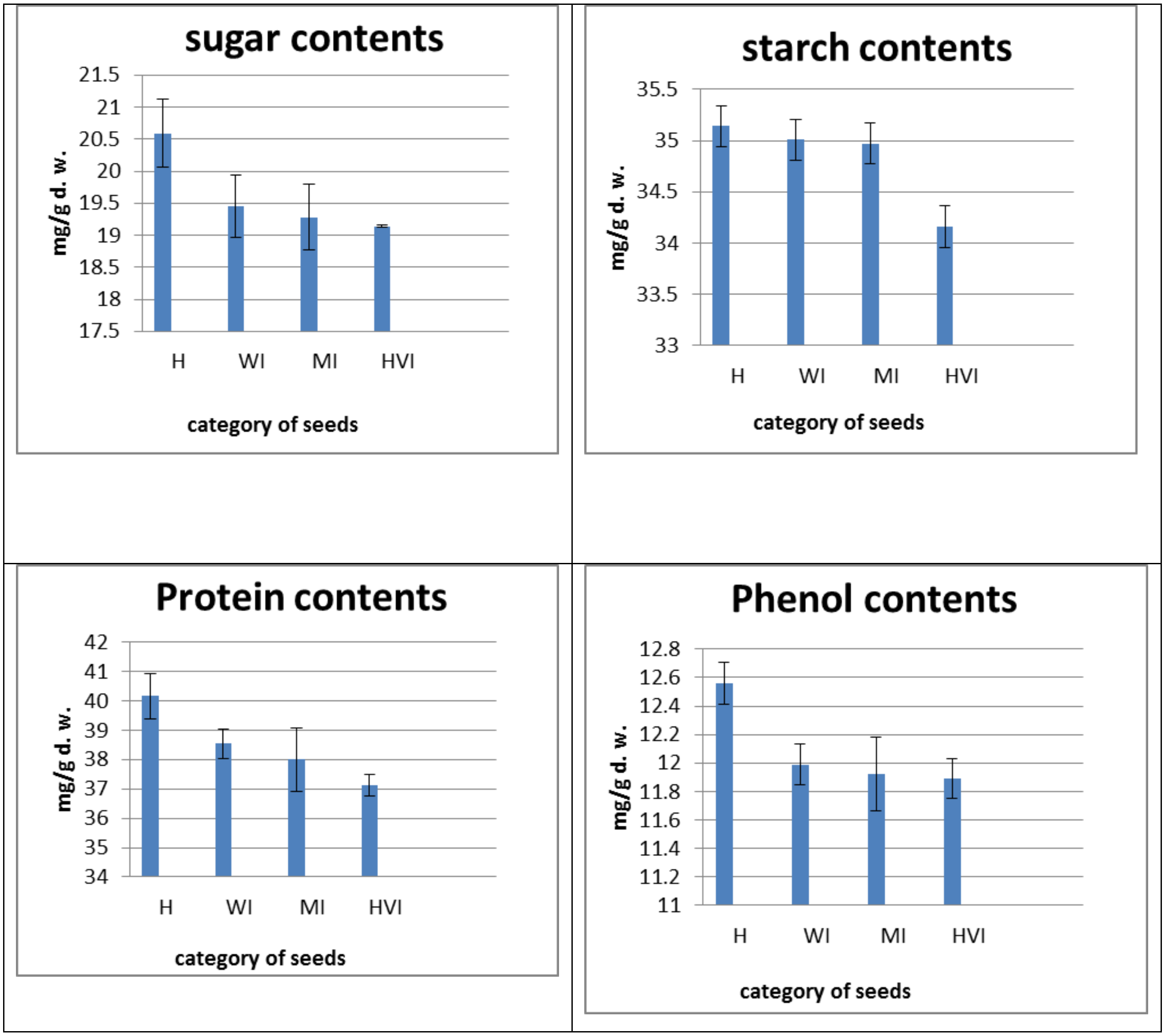

Figure: 1 Amount of sugars, starch, phenols and protein in seeds of healthy (control) (H) and naturally infected (weakly (WI), moderately (MI) and heavily (HVI)).

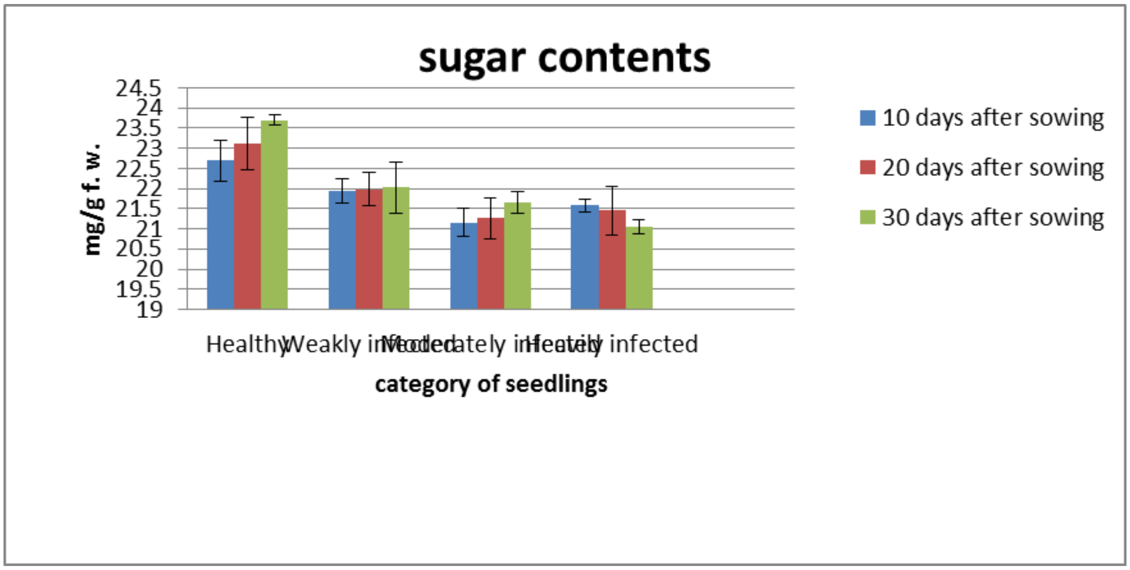

Figure: 2 Amount of sugars in seedling of healthy (control) and naturally infected (weakly, moderately and heavily) on 10th, 20th and 30th day of sowing.

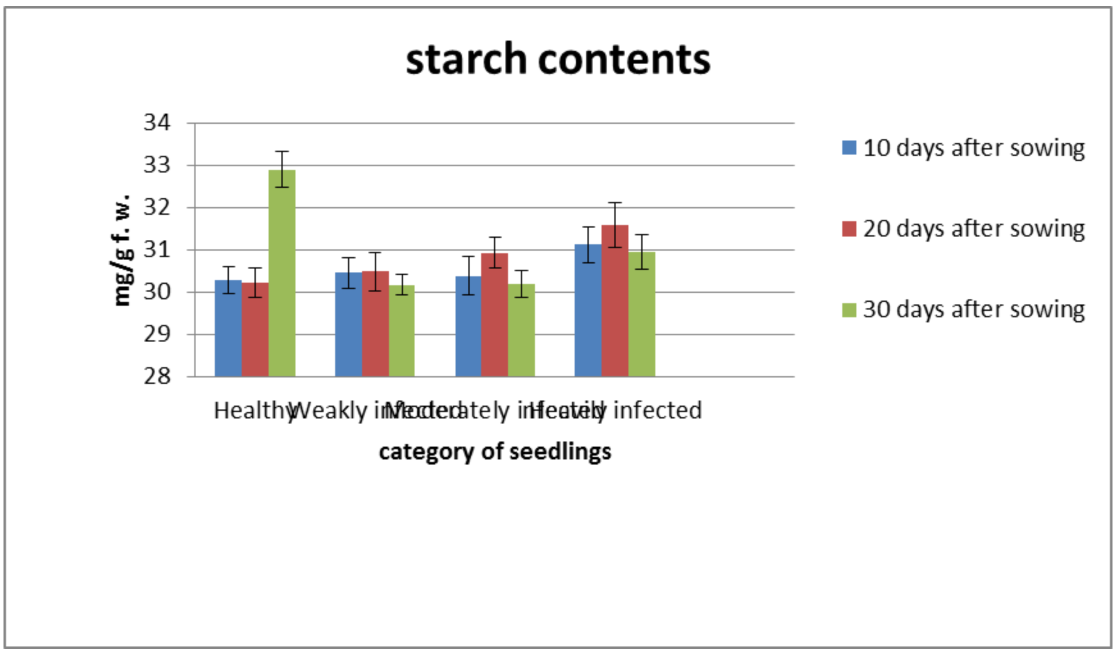

Figure: 3 Amount of starch in seedling of healthy (control) and naturally infected (weakly, moderately and heavily) on 10th, 20th and 30th day of sowing.

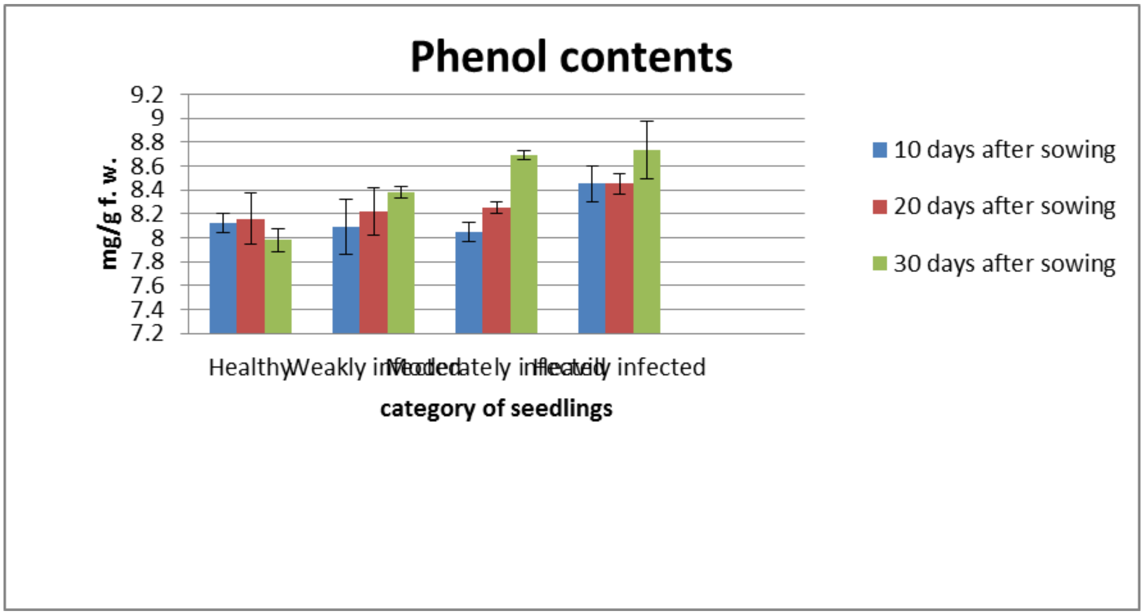

Figure: 4 Amount of phenols in seedling of healthy (control) and naturally infected (weakly, moderately and heavily) on 10th, 20th and 30th day of sowing

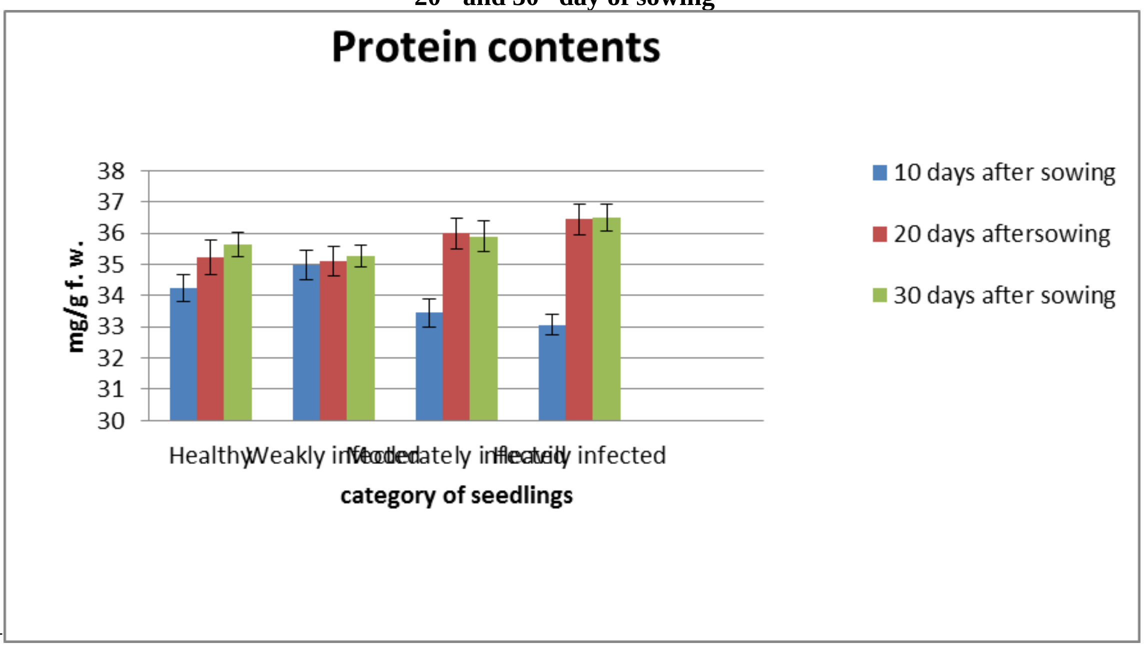

Figure: 5 Amount of proteins in seedling of healthy (control) and naturally infected (weakly, moderately and heavily) on 10th, 20th and 30th day of sowing

V. DISCUSSION

Sugar decreased after infection because it is a good source of food and carbon and is easily digested by the fungus. Fungi acquire sugars to fuel additional fungal growth. Ushamalini, C (1998) reported the effect of seed borne fungi *Fusarium oxysporum* on cowpea. Fungus caused maximum reduction in sugars compared to other fungi in cowpea[7]. Sondeep Singh *et al* (2009) reported a gradual increase in the levels of total free sugars till 15 DAI in both genotypes PL 426 BL4 infected with leaf blight and thereafter sugar level declined which may be correlated to the utilization of sugars from leaves[8]. Angra Sharma *et al*. (1993) showed involvement of carbohydrates during pathogenicity, serving as constant energy sources for the growing pathogen has been indicated in *Helminthosporium maydis*, *H. carborum and H. teres*[9].

The decline in starch contents in the infected seedlings may be due to the infection proceedings. Singh, Archana also supported high levels of proteins, total sugars, total starch, phenolics and peroxidase activity in the infected seedlings as compared to healthy[10].

The presence of higher levels of proteins and phenols in infected tissues may be implicated in resistance of the host to infection. Fungi synthesize several enzyme proteins and sometimes cause rearrangement of nutritional composition of substrate due to formation of several degradation products thereby increase its protein contents. Proteins and phenols may be responsible for the delay and decline in number of germinations appressoria, penetrations and colonisations at the onset of infection[11]. R. Angra Sharma and D K Sharma (1994) reported high levels of protein and phenolic compounds in the resistant variety compared with the susceptible host. The levels of lipids were, however, lower in the resistant host and decreased with the time of incubation of the host pathogen complex. Higher levels of proteins, lignins, phenolics and callose synthesized in the resistant variety may play a role in inhibiting the infection[12].

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