

## **DIFFERENCES IN PROTEIN CONTENT IN LEAVES OF RESISTANT AND SUSCEPTIBLE VARIETIES OF WHEAT (*TRITICUM AESTIVUM*) AFTER INFECTION WITH BROWN RUST FUNGUS (*PUCCINIA RECONDITA*)**

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### **Abstract**

Protein content in 8 different varieties of wheat after infection with *Puccinia recondita*, the brown rust fungus was examined. Protein content showed an increase in resistant and moderately resistant varieties upto 3 days which later declined. In susceptible and moderately susceptible varieties no significant change in protein content was observed after 3 days, which later increased and showed maximum increase after 5 days, with a sharp decline after 7 days interval. Resistant varieties were significantly different in protein content as compared to susceptible varieties.

### **Introduction**

Wheat, an important cereal crop, is cultivated over 6.9 m ha in Pakistan (Hafiz, 1986). Of the various diseases, the rust disease of wheat produce an annual loss of Rs. 30-40 m (Hafiz, 1986) where resistant varieties are generally recommended for its control. The basis of resistance is due to biochemical defense mechanism based on the presence or absence of chemical substances which interfere with the invasion of the pathogen (Pan *et al.*, 1993). The nature of resistance of the host is determined by the initial stimulus produced by the pathogen (Daly, 1976; Tomiyama *et al.*, 1979). An increase in total protein content of the host during early stages of infection has been reported by Hammer schmidt *et al.*, (1982) and Grebenchuk *et al.*, (1984). A correlation between protein synthesis and disease resistance was observed in oat infected by *Puccinia coronata* (Tani & Hiroyuki, 1979). An experiment was carried out to examine protein content in 8 different varieties of wheat showing different degrees of resistance to infection by brown rust fungus, *Puccinia recondita*.

### **Materials and Methods**

Seeds of 8 different varieties of wheat (*Triticum aestivum*) viz., Pak-81 (resistant), Pavon, ZA-77, Sindh-81 (moderately resistant), Jauhar-78, Blue silver (moderately susceptible), Mexi-Pak and Pak-70 (susceptible) which showed different degrees of resistance/susceptibility to brown rust fungus according to status of 1989-90, obtained from Pakistan Atomic Energy Agricultural Research Centre, Tandojam, were used. Inoculum of uredospores of *Puccinia recondita* was obtained from Cereal Disease Lab., of PARC Sunny Bank, Murree, Pakistan.

Wheat seeds surface disinfected with 0.1% mercuric chloride were sown in 10 m<sup>2</sup> plots supplemented with nitrogen and phosphorus in 10:7 ratio. Forty day old plants were inoculated with a spore suspension of uredospores of *P. recondita* @ 250 spores/drop. Leaf samples were collected at 24 h interval for a period of 5 days and then at 48 h interval for 15 days.

Total protein content was determined by the method of Lowry *et al.*, (1951) where proteins were extracted in 0.5 N NaOH and estimated by alkaline copper and Folin phenol reagent. Optical densities were measured at 750 nm against reagent blank. Amount of total protein were calculated with the help of standard graph and expressed as  $\mu\text{g}/\text{mg}$  dry weight.

## Results

Significant changes ( $p < 0.001$ ) in the total protein content were observed in all the 8 varieties of wheat after inoculation with the uredospores of brown rust fungus (Fig.1). Resistant variety Pak-81 (56.8%) alongwith moderately resistant varieties viz., Pavon (55.9%), ZA-77 (47.6%) and Sindh-81 (40.1%) showed a significant increase in total protein content one day after inoculation (Fig.1). The protein content declined from the 4th day which continued upto 9th day in Sindh-81 and ZA-77 and upto 11th day in Pavon and 13th day in Pak-81 followed by a slight increase at subsequent sampling.

In moderately susceptible Jauhar-78 (70.4%), Blue Silver (62.0%) and susceptible varieties Mexi-Pak (60%) and Pak-70 (62.9%), no significant increase in total protein content was observed upto 3rd day of inoculation (Fig.1). A significant increase ( $P < 0.001$ ) in protein content was observed on the 4th and 5th day after inoculation followed by a decrease on 7, 11 days of sampling which later increased in all the varieties upto 15 days of the experimental period. This increase was comparatively higher in susceptible than moderately resistant and resistant varieties (Fig.1).

## Discussion

The results of the present studies shows that resistance in wheat varieties is either due to synthesis of some new protein or an increase in the synthesis of existing proteins. A correlation between protein synthesis and disease resistance in oat leaves infected by *P. coronata* has been reported (Tani & Hiroyuki, 1979). Increase in protein content was also observed in flax infected with *Melampsora lini* (Von Broembsen & Hadwiger, 1972). The possible role of proteins specific in disease resistance have been reported in Khapli wheat infected by stem rust (Samborski *et al.*, 1958) where synthesis of 2 new proteins was demonstrated after infection. Inoculation of resistant variety of tobacco with blue mold fungus also induced changes in protein and enzymes in tissues surrounding the locus of infection (Pan *et al.*, 1991). These changes are accompanied by local resistance of the tissue to the virulent strains of pathogens (Uritani, 1971). Sweet potato infected by *Ceratocystis fimbriata* showed marked increase in 9 out of 13 enzymes studied (Uritani & Stahmann, 1961). At least one of the stimulus for increased rate of enzyme or protein synthesis is ethylene which is produced by the infected tissues and moves from the areas of initial infection to the adjoining tissues where it initiates

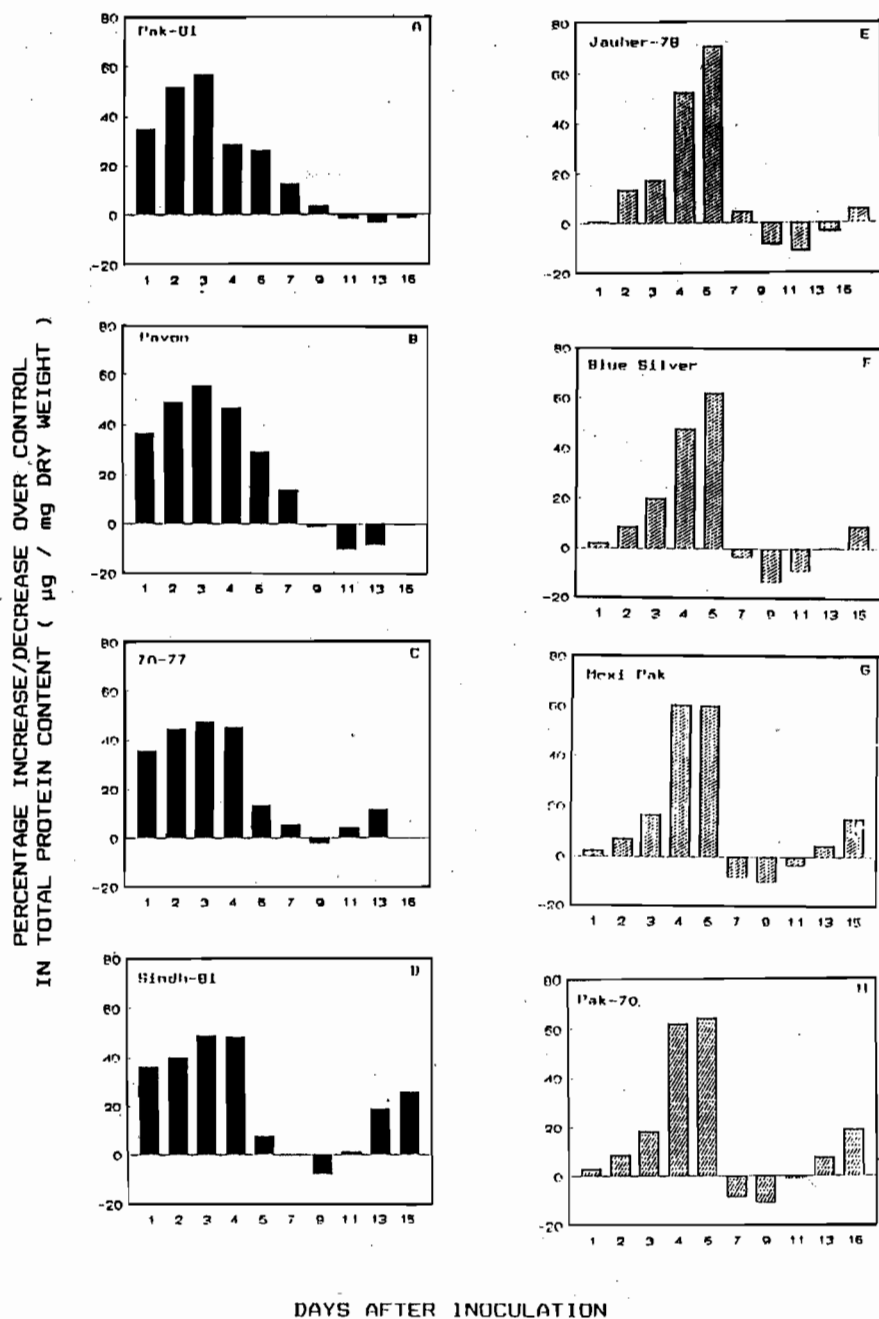


Fig. 1. Percentage increase/decrease in total protein content in eight different varieties of wheat (*Triticum aestivum*) after inoculation by uredospores of *Puccinia recondita*.

protein synthesis which might lead to resistance or blocking of further penetration by the pathogen (Agrios, 1969).

The delayed increase in total protein in susceptible and moderately susceptible varieties of wheat suggests that probably in these varieties the increase is mainly due to protein content of the pathogen and not of the host since it took 3 days for the establishment of the brown rust fungus. A decrease of the enhanced protein synthesis in rust infected bean leaves has been reported (Pozsar *et al.*, 1966).

The observed decrease in total protein content in resistant and moderately resistant wheat varieties from 4th day after inoculation may be attributed to their hypersensitive reaction resulting in the cell death. It has been demonstrated that resistant varieties respond very quickly against pathogen (Dickson & Lucas, 1977; Ouchi, 1983) while the tissues of the susceptible varieties remained alive for a longer period. The delayed increase in total protein content in susceptible and moderately susceptible varieties may be due to breakdown of cell structures of infected tissues and an increase in the concentration of proteolytic enzymes (Rudolph, 1963).

The results of the present study would indicate that the activation of defense mechanism in resistant varieties is either due to synthesis of some new proteins or due to increase in concentration of some pre-existing proteins or enzymes and that resistance or susceptibility can be determined at early stages of infection.

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(Received for Publication 6 June 1994)