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# TOTAL PHENOLS AND SUGAR CONTENT IN WHEAT RESISTANT AND SUSCEPTIBLE CULTIVARS AGAINST KARNAL BUNT

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## Abstract

Wheat (*triticum aestivum* L.) is the most extensively grown cereal crop and stable food for over 10 billion people of world. Wheat accounts 30 per cent in production amongst all cereal crops followed by rice (27%) and maize (25%). It is a major source of energy, protein and dietary fiber in human nutrition (Kaur *et al.*, 2016). In India, wheat is second import crop next to rice, the current year (2016-17) production has reached an all-time record of 97.44 mt with an average national productivity of 3172 kg/ha (ICAR-IIWBR 2017).

***Key words:*** *Triticum aestivum,* wheat resistant, susceptible cultivars.

## Introduction

Karnal bunt of wheat caused by *Neovossia indica* is major constraints in wheat-growing areas of north-western India. Although the Karnal bunt causes only a minor loss in yield, it is a potential threat to international trade of commercial grain due to lowering of seed quality (Royer and Rytter, 1988). Karnal bunt disease was responsible for an annual loss of 40,000 mt of growers per year during late sixties (Munjal, 1975). To date progress in managing this disease has been made in fields of cultural, biological, chemical control and host resistance (Singh *et al.,* 1994). A number of wheat genotypes have been identified as resistant sources to *N. indica* (Gill *et al.,* 1993). However, a search for the success in breeding true resistant varieties for most effective, economical and ecological safe control strategy would be increased.

The biochemical mechanism involved in plant disease resistance is a complex phenomenon. Yet total phenols and sugars have long been considered as important defence-related compounds. Phenolics are well-known antifungal, antibacterial and antiviral compounds occurring in plants (Sivaprakasan and Vidhyasekaran, 1993). The first step of the defence mechanism in plants involves a rapid accumulation of phenols at the infection site (Matern and Kneusal, 1988). Phenolics and their oxidation products are toxic to a variety of microorganisms and their enzymes and toxins (Bajaj *et al*., 1983). The involvement of different types of sugars results in the multiplicity of phenolic glycosides (Walker, 1975).

## Materials and Method

Four bread wheat genotypes, WH 1080 and JAUW 598, which is highly resistant to KB and HD 2009 and WL 711, which is highly susceptible were used. The leaf samples were collected from healthy as well as inoculated wheat plants at the booting stage of both resistant and susceptible varieties. The highly aggressive isolate of *N. indica* was used for studied.

Inoculum was prepared from 7 to 8 days old culture of *N. indica* with viable secondary sporidia and the concentration of the suspension was adjusted to $10^3$-$10^4$ sporidia per ml. The wheat lines were inoculated at the booting stage (Code 45, Zadok's Scale) by injecting 0.5 ml of sporidial inoculums following the method of Chona *et al.* (1961). Inoculated ear heads were collected at 0, $4^{th}$, $10^{th}$ and $20^{th}$ days after inoculation (DAI) for the estimation of total phenol, total sugar, reducing sugar and non-reducing sugar. One hundred mg oven dried samples were homogenized in 80 per cent ethanol (v/v). The homogenate was refluxed for 15 minutes on a water bath at $60^0$C and centrifuged at 10,000 rpm for 20 min. The residue was further refluxed thrice with 80 per cent ethanol. The supernatants were pooled together and volume was made to 10 ml with 80 per cent ethanol. Total phenols were extracted and estimated by the method

of Swain and Hillis (1959). Total soluble sugars were estimated by the method of Dubois *et al.* (1956). Reducing sugars were estimated by the method of Walter (1924). Non-reducing sugars were estimated by the method of Nelson (1944), by subtracting reducing sugars from total sugars.

## Results

The quantitative contents of total phenols, total sugar, reducing sugar and non-reducing sugar in four wheat cvs. was presented in Table 1. Total phenol contents were higher in healthy leaves of resistant varieties (WH 1080 and JAUW 598) as compared to healthy leaves of both susceptible varieties (HD 2009 and WL 711). After inoculation, the total phenol contents increased in both resistant and susceptible varieties at 4$^{th}$ day of inoculation thereafter; there was decrease on 10$^{th}$ and 20$^{th}$ day after inoculation. However, the amount of total phenol contents was higher at all the stages of infection in resistant variety as compared to susceptible variety. Similar trend was obtained for Total sugars, reducing sugar and non-reducing sugar in both resistant and susceptible varieties.

Phenolic compounds are widely distributed in higher plants and are involved in disease resistance (Bhaskaran *et al.,* 1975). The phjenolic compounds act as hydrogen donors/acceptors in host-parasite interaction during host-pathogen interaction. These compounds also interfere with growth and energy dependent activities by uncoupling oxidative phosphorylation. The differences in phenolic and sugar content between the cultivars and also between the stages are parallel to the observation that fungal development is inhibited due to physiological changes in plant tissues with increase with the age of plant (Patil *et al.,* 2010 and Thind *et al.,* 1977). Similar changes in phenol status upon infection were reported for *N. indica* in resistant lines of wheat (Gill *et al.,* 1993 and Gogoi *et al.,* 2001) and against the loose smut (Saini *et al.,* 1988). In present study, total sugar, reducing and non-reducing sugar level was higher in resistant cultivars in compression to susceptible. Sugar level increased after two days inoculation but their after decline drastically. Similar results were reported by Saini *et al.,* 1988 and 1982). The involvement of different types of sugars results in the multiplicity of phenolic glycosides (Walker, 1975).

**Table 1:** Effect of karnal bunt disease on biochemical parameters of resistant and susceptible wheat varieties at booting stage.

| Biochemical parameter | Variety | 0 DBI | 2 DAI | 7 DAI | 14 DAI |
|---|---|---|---|---|---|
| Total Phenoles (mg/g, dry wt. basis) | WH 1080 (R) | 14.43 | 21.97 | 17.25 | 9.65 |
| | JAUW 598 (R) | 13.75 | 20.30 | 17.50 | 10.00 |
| | HD 2009 (S) | 8.15 | 10.46 | 9.25 | 06.10 |
| | WL 711 (S) | 8.02 | 11.13 | 9.55 | 7.25 |
| Total Sugars (mg/g, dry wt. basis) | WH 1080 (R) | 38.94 | 49.84 | 41.12 | 31.10 |
| | JAUW 598 (R) | 36.12 | 45.05 | 41.33 | 29.56 |
| | HD 2009 (S) | 29.30 | 31.10 | 27.50 | 19.20 |
| | WL 711 (S) | 27.45 | 29.55 | 21.00 | 16.90 |
| Reducing sugar (mg/g, dry wt. basis) | WH 1080(R) | 11.10 | 12.35 | 08.33 | 05.91 |
| | JAUW 598 (R) | 12.65 | 14.45 | 12.97 | 8.025 |
| | HD 2009 (S) | 08.25 | 09.66 | 06.42 | 04.06 |
| | WL 711 (S) | 09.10 | 12.25 | 6.25 | 03.05 |
| Non-reducing sugar (mg/g, dry wt. basis) | WH 1080 (R) | 16.45 | 17.78 | 14.51 | 11.19 |
| | JAUW 598 (R) | 18.25 | 21.50 | 16.25 | 12.50 |
| | HD 2009 (S) | 11.55 | 12.10 | 10.55 | 8.25 |
| | WL 711 (S) | 12.45 | 13.45 | 10.08 | 07.30 |

R= Resistance, S= Susceptible

In conclusion, the present study indicated that the biochemical basis of resistance in wheat against *N. indica* is the same in all genotypes. Such defence mechanism in the resistant is activated immediately after inoculation or infection by *N. indica* and same mechanism may be operated in susceptible genotypes but it starts quite slowly and reaches comparatively low level.

## Reference

Bajaj, K.L., Y.K. Arora and R. Mahajan (1983). Biochemical differences in tomato cultivars resistant and susceptible to *Meloidogyne incognita. Rev. Nematol.*, **6**: 143-145.

Bhaskaran, R., C. Natrajan and D. Mohanraj (1975). Biochemistry of resistance and susceptibility in cotton to *Alternaria macrospora*. *Acta Phytopathol*. **10**: 30-40.

Chona, B.L., R.L. Munjal and K.L. Adlakha (1961). A method for screening wheat plants for resistance to *Neovossia indica*. *Indian Phytopathology,* **14**: 99-101.

Dubois, M., K.A. Gills, J.J. Hamilton, P.A. Rebress and F. Smith (1956). Colorimetric method for determination of sugar and related substances. *Anal. Chem*., **28**: 350-356.

Gill, K.S., G.S. Nanda, G. Singh, K. Chand, S.S. Aujla and I. Sharma (1990). Study of gene effect for karnal bunt (*Neovossia indica*) resistance in bread wheat (*Triticum indicum* L.). *Indian Journal of Genetics*, **50**: 205-9.

Gogoi, R., D.V. Singh and K.D. Srivastava (2001). Phenols as a biochemical basis of resistance in wheat against Karnal bunt. *Plant Pathology,* **50**: 470-476.

ICAR-IIWBR (2017). *Director's Report of AICRP on*

*Wheat and Barley* 2016-17, Ed: G.P. Singh. ICAR- Indian Institute of Wheat and Barley Research, Karnal, Haryana, India. P.87.

Krog, N.E., D.L. Tourbeau and H. Hart (1961). The sugar content of wheat leaves infected with stem rust. *Phytopathol.*, **51** :75-77.

Matern, U. and R.E. Kneusal (1988). Phenolic compounds in plant disease resistance. *Phytoparasitica,* **16**: 153-70.

Nelson, N. (1944). A photometric adaption of the somogamy method for the determitation of glucose. *J. Biol. Biochem*., **153**: 375-380.

Royer, M.H. and J. Rytter (1988). Comparison of host ranges of *Tilletia indica* and *T. barclayana*. *Plant Disease*, **72**(2):133-136

Saini, R.S. (1982). Biochemical studies on wheat in relation to loose smut disease. M. Sc. Thesis, Haryana Agricultural University. Hisar, Haryana.

Saini, R.S., Y.K Arora, H.K.L. Chawla and D.S. Wagle (1988). Total Phenols and Sugar Content in Wheat Cultivars Resistant and Susceptible to *Ustilago nuda* (J ENS.) Rostrup. *Biochem. Physiol. Pflanzen,* **183**: 89-93.

Singh, D.V., K.D. Srivastava and R. Aggarwal (1994). Recent advances in Karnal bunt research. In: T. Singh, P.C. Trivedi, eds. Vistas in Seed Pathology. Jaipur, India: Printwell, 156-65.

Sivaprakasan, K. and P. Vidhyasekaran (1993). Phenylalanine ammonia lyase gene for crop disease management. In: Vidhyasekaran P, ed. Genetic Engineering, Molecular Biology and Tissue Culture for Crop Pest and Disease Management. Delhi, India: Daya Publishing House, 113-22.

Swain, T. and W.E. Hillis (1959). The phenolic constituants of *Prunus domestica* L. The Quantitative analysis of phenolic constituents. *J. Sci. Fd. Agric*., **10**: 63-69.

Thind, T.S., S.B. Saksena and S.C. Agarwal (1977). Post infection changes in amino acids, sugars, phenolic substances and organic acids of apple fruit infected by *Clathridium corticola*. *Indian Phytopathol*., **30**: 323-325.

Walker, J.R.L. (1975). The Biology of Plant Phenolics. Edward Arnold Publication. U. K.

Walker, T. (1924). The colorimetric determination of carbohydrates in plants by picric acid reduction method. The estimation of reducing sugars and sucrose. *J. Amer. Chem*. Soc., **46**: 1670-1674.