Differential Chemosensory Responses in Wild, Unadapted Groundnut Germplasm and Susceptible Cultivar to Rust (*Puccinia arachidis* Speg.)

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Rust is a serious disease causing severe yield losses in many groundnut-growing countries of the world. Genetic resistance to this disease in the cultivated groundnut is almost lacking. However, several species of the genus *Arachis* are immune or resistant to this disease (Subrhamanyam *et al.* 1980) and offer immense scope to breed cultivars having wider and differential genetic resistance. Before utilizing these sources of resistance in the breeding programmes, understanding the mechanisms of resistance is essential. Oxidative stress has been one of the various defence responses implicated in the disease resistance and have consequently been the subject of much research. However, with reference to groundnut, studies are meagre. Groundnut offers a unique opportunity, as all the three types of disease reaction classes are available in their gene pool. Hence, an experiment was carried out to understand the role of the oxidative stress in one immune wild *Arachis* species (*Arachis cardinasii*), a resistant and unadapted land race (NcAc 17090) and a susceptible check (TMV 2).

Since it is difficult to measure the short-lived super oxide radicals produced as a defense response, the activities of scavenger enzymes that utilize these radicals namely super oxide dismutase (SOD) and peroxidase (Po) were estimated quantitatively.

The experimental materials consisted of a fully expanded undamaged leaf excised with intact petiole through the pulvinous from each plant at the third node from the terminal bud of the main stem. The leaves were washed with sterile water and inserted in a layer of sterilized sand in plastic trays (45 x 30 x 14 cm). The sand was moistened with Hogland's nutrient solution. For each genotype four replications were maintained. The uredospores were collected from the diseased plants of TMV 2 using a cyclone spore collector. Suspensions of uredospores were prepared (50000 spores/ml) in sterile water containing the wetting agent Tween 80 (0.2 ml/lit of water). The spore suspensions were automized over the leaves inside the tray and covered with 250 gauge polythene sheets. The trays were then placed in plant growth chamber adjusted to 25°C and a 12 h photoperiod. The enzyme assays were carried out at 1, 3, 5, 7, 10 and 14 days after inoculation. The activity of superoxide dismutase enzyme was measured by the method of superoxide mediated ferricytochrome reduction (McCord and Fridovich, 1969) and one unit of SOD activity was defined as that which inhibited 50% of the reaction rate/cm^2 leaf area. Peroxidase activity was measured following the method of Hammerschmidt *et al.* (1982) and expressed as increase in absorbance at 470 nm/min/g of fresh leaf tissue.

The super oxide dismutase (SOD) and peroxidase (PO) enzymes were active from day one after inoculation, reached the peak within third and fifth day, respectively, declined rapidly thereafter and dropped down to a very low level by 14 days after inoculation. The activities of these two enzymes were initially very low in case of susceptible genotype, but increased from 5th day onwards, reached the peak by the 10th day and thereafter declined rapidly (Fig. 1).

Rapid generation of superoxide and accumulation of hydrogen peroxide are characteristic features of the hypersensitive response following the perception of pathogen avirulence signal. These oxidants act not only as protective agents of the cells against the pathogen, but also function as a substrate for oxidative cross-linking as a threshold trigger for hypersensitive cell death. However, in groundnut rust, these radicals may be channelised for the lignification of the host cell wall, which in turn may act as a physical/chemical barrier for further pathogen ingress (Rathnakumar and Balasubramanian, 2000).

Subrhamanyam *et al.* (1983) have reported that in both the wild and cultivated groundnut the rust uredosori germinated on the leaf surfaces and the fungus entered

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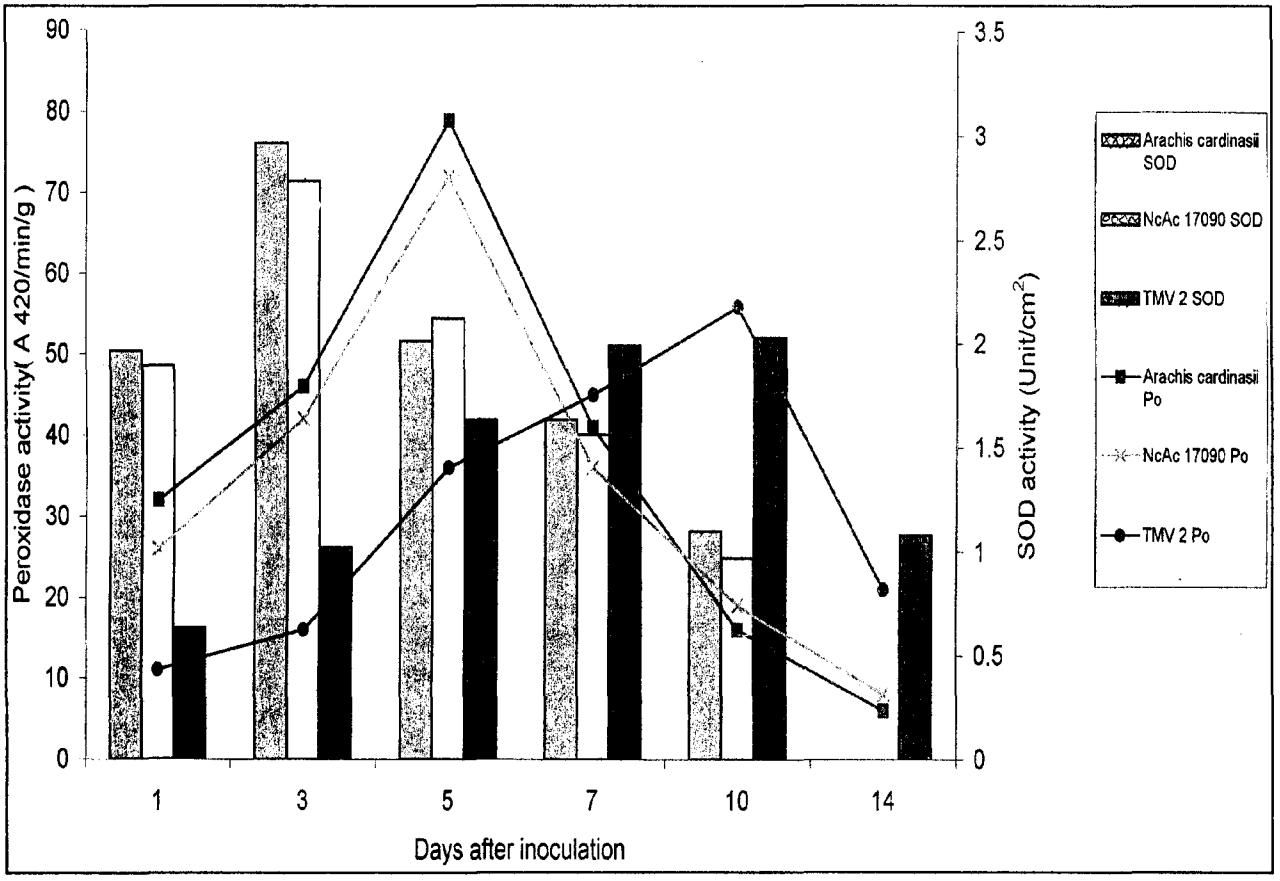

Fig. 1. Activities of Superoxide Dismutase and Peroxidase following Uredospore Inoculation

through the stomata irrespective of whether a genotype was immune, resistant and susceptible and in the immune species the fungus died shortly after entering the sub stomatal cavity. The present study clearly indicated through the enzyme activities that the super oxide radicals were produced in all the three reaction classes but much earlier in the immune and resistant genotypes and at a much later stage in the susceptible genotype.

The study has also shown that in the susceptible cultivar, although the enzyme activities were comparable to that of immune or resistant germplasm, the accumulation of toxic products occurred at a time and speed that could not contain the development of the disease indicating that susceptibility is not due to the lack of genes for resistance. It is proposed that in groundnut rust two distinct chemosensory perception systems–one for immunity and the other for susceptibility may operate.

The study also indicated that these two enzymes may be used as biochemical markers of rust resistance for preliminary screening of large number of germplasms under epiphytotic conditions.

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