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# Studies on thermo-tolerance, germination behaviour and activity of guaiacol peroxidase enzyme in pea (*Pisum sativum* L.) and soybean [*Glycine max* (L.)Merr.] seeds during early stages of germination

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**SUMMARY**

The effect of high temperature treatment on seeds of pea and soybean was investigated, taking the germination percentage, moisture content, seed vigour index and changes in the guaiacol peroxidase enzyme activity in the temperature- treated and control seeds of pea and soybean during the early stages of germination, as parameters of thermo-tolerance. Seeds could withstand the effect of high temperature treatment up to 70$^0$C for ten days continuously, retaining viability but high temperature treatment reduced the rate of germination percentage, moisture content, seed vigour index as well as increased the production of guaiacol peroxidase enzyme activity in order to protect the oxidative injury and heat-stress in the tissue of germinating seeds/seedlings. The pea and soybean showed metabolic adaptations to tolerate heat-stress and this is very relevant to agronomists in the changing climatic conditions.

**Key words :** Agronomists, Germination percentage, *Glycine max*, Guaiacol peroxidase enzyme activity, Heat-Stress, Metabolic adaptations, Moisture content, Oxidative injury, *Pisum sativum*, Seed vigour index, Thermo-tolerance

The experimental plants selected for the present study are green pea (*Pisum sativum* L.) and soybean [*Glycine max* (L.) Merr.], belong to family Fabaceae. *Pisum sativum* and *Glycine max* are the domesticated plants with the widest range of uses in both agricultural and horticultural field. Soybean is the third largest oil seed crop in India (Bhatnagar and Tiwari, 1991).

Viability is tested in terms of percentage of germination. Seed viability denotes the degree to which a seed is alive, metabolically active and possesses enzymes necessary for catalyzing metabolic reactions needed for germination and seedling growth (Basara *et al*., 2002). Cabrera and Boyd (1988) evaluated the effect of temperature in the range of 50 to 70$^0$C and moisture content of 7.5 to 14.5% on germination of gin-run cottonseed. They found that heat stress reduced the viability and vigour at 70$^0$C or higher. According to Gelmond *et al.* (1978) the seed vigour means a high rate of the overall biological activities of the seed, resulting in a high yield performance. They measured and predicted seed vigour according to the rate of root emergence of germination or field emergence. Vigour represents the potential ability of the seed to yield the maximum plant product at the earliest time under variable environmental field conditions.

When plants are subjected to environmental stress, the balance between the production of reactive oxygen species and the quenching activity of antioxidants is upset resulting in oxidative damage. Plants with high levels of antioxidants have been reported a greater resistance to oxidative damage (Hernandez *et al.*, 2001). The abiotic stress such as high level of temperature and radiation, salinity, drought etc. may cause the generation of oxidative stress (Foyer and Noctor, 2000). The oxidative stress is characterized by the over production of highly active oxygen species (AOS), represented predominantly by superoxide anion ($O_2$)-, hydrogen peroxide ($H_2O_2$), hydroxyl radical (·OH) and singlet oxygen ($^1O_2$). Plants have defensive mechanisms and utilize several biochemical strategies to avoid damage caused by AOS. Plant enzymatic defenses include antioxidative enzymes such as peroxidases, superoxide dismutase and catalase that promote the scavenging of AOS (Hernandez *et al*., 2001). Peroxidase is widely distributed in all higher plants and protects cells against the destructive influence of $H_2O_2$ by catalyzing its decomposition through oxidation into $O_2$ and $H_2O$ (Dionisio-Sese and Tobita, 1998; Sudhakar *et al*., 2001). Active oxygen species and the degree of damage depend on the balance between the

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