Effects of Low Temperature Stress on Chickpea (*Cicer arietinum* L.)

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Abstract—*Cold stress is one of the prominent abiotic stresses that decreases productivity and global distribution of plants on earth. Low temperature stress impairs source-sink relationship, absorption of water, cellular metabolism that leads to oxidative stress. Chickpea (Cicer arietinum L.) is a cool season crop and its reproductive phase coincides with low temperature (<10°C) that causes abortion of flowers and pods leading to poor yield. Therefore, in the present study, we have evaluated four chickpea genotypes (ICC 16348, ICC 16349, GPF-2 and PBG-1) having contrasting cold sensitivity for their reproductive growth subjected to cold stress (average day temperature: 17.6 °C; average night temperature: 4.9 °C). Two genotypes (ICC 16348 and ICC 16349) showed flowering and pod set, while other two cold sensitive genotypes (GPF-2 and PBG-1) failed to do so during the stress conditions indicating the former to be cold tolerant. Apart from this, cold stress led to some vegetative aberrations like chlorosis, necrosis of leaf tips and accumulation of anthocyanin in leaves. The damage to reproductive stage involved abscission of juvenile buds, flowers and abortion of pods. On the whole, pollen development at young microspore stage appeared to be severely affected in sensitive genotypes as compared to the tolerant genotypes. Pollen viability and stigma receptivity were reduced in sensitive genotypes as compared to tolerant genotypes; in vivo pollen germination and pollen tube growth were more inhibited in sensitive than tolerant genotypes. Fluorescent studies showed no pollen load on stigma and inhibited pollen germination on its surface in cold sensitive plants. Mostly, the pollen tubes were impaired in their growth and did not reach the ovules leading to failure in fertilization. Biochemical parameters associated with carbohydrate metabolism were also evaluated in these contrasting genotypes and it was analysed that activity of sucrose synthase and starch content in cold tolerant genotypes was more than that of cold sensitive genotypes. On the other hand, the content of reducing sugars was more in cold sensitive genotypes as compared to cold tolerant genotypes.*

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