

Chemical applications improve cotton yield by alleviating water stress in cotton belt of Punjab (south-

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Cotton is an important cash crop during *Kharif* season that is growing for textile industries. In Punjab, cotton is grown on an area of 249 thousand hectares with a total production of 639 thousand bales. In the state, cotton is a second major *Kharif* season crop after rice which is mostly grown under south-western districts of Punjab where irrigation water is a major problem during *Kharif* season because of scanty rainfall and extended canal closures as well as brackish underground water. Consequently, the delayed monsoons, non-availability of canal water or failure of irrigation facilities often create moisture deficit conditions in the cotton growing areas resulting declined seed cotton yield up to 42.9 %. The foliar application of Osmo protectants such as Glycine betaine and salicylic acid at appropriate concentration and time may be an effective approach for sustaining the high cotton productivity under water deficit scenarios.

Causes of water stress

In the south-western districts of Punjab, crops depend more on canal water and rainfall than underground water because of brackish underground water. So, meager rainfall and canal closure causes irrigation water deficit conditions.

Effect of water stress on cotton

Cotton is warm season crop required 4-6 irrigations depending upon the seasonal rainfall but peak vegetative and early reproductive stage is sensitive to water deficit conditions, causing a significant reduction in yield of up to 42.9 % as well as the fibre quality and biomass yield of the crop up to 55 %. Timely availability of irrigation water to cotton remains the main production hurdle to sustain cotton productivity in cotton belt of Punjab.

1058



Mitigation strategies to overcome water stress on cotton

Farmers need to understand the appropriate time and quantity of irrigation water to the cotton crop. A heavy pre-sowing is required and first irrigation applies after 30-35 DAS. During peak vegetative stage and early reproductive stage, proper application of water may reduce the adverse effects of water scarcity during rest of the season. Proper use of nitrogenous fertilizer (30-42 kg/ha depends on the varieties and hybrids) also improve water absorption capacity of the plant roots.

Chemical management to overcome effect of water stress

In water shortage conditions, plants are unable to retain water from their roots due to low osmotic pressure in the root cells, so certain chemicals found by researchers increase osmotic pressure, which eventually increases the ability of roots to absorb water. With a certain concentration, some chemicals such as Salicylic acid and Glycine betaine can effectively counteract the harmful effects of water stress on cotton crops. Some important aspects are described below: -

Preparation of solution

Prepare solution for Salicylic acid and Glycine betaine @ 100 ppm. In simple language, to prepare a 100-ppm solution, take 10 ml of Salicylic acid and Glycine betaine in 100 liters of water. Dissolve 12.5 g Salicylic acid or Glycine betaine in 375 ml of Ethyl alcohol and then add it to 125 liters of water for one acre area of cotton crop.

Table 1: Concentration of different chemicals used to overcome effect of water stress

	Parts per million (ppm)	Percent solution (%)	In 125 L of water
Salicylic acid	100 ppm	0.01	12.5 g
Glycine betaine	100 ppm	0.01	12.5 g



a) Chemical applied on water stressed crop

b) Water stressed cotton crop

Fig.1: Effect of Salicylic acid and Glycine betaine spray on the water deficit cotton crop.



Mode of application

The water stress can be effectively overcome by foliar application with sufficient solution concentration.

Selection of spray pump and nozzle

Foliar spraying can be done with knapsack sprayer (manually or battery operated) or tractor operated sprayer with cone type nozzle. Mostly 125-150 liter of water is required per acre, so prepare solution according to quantity of water / area to be sprayed.

Method of foliar spray

Nozzle height at the time of spraying is very important. Maintain nozzle height around 1.5 feet from the crop canopy during spraying.

Time of spray

Water stress at the peak vegetative and early reproductive stage affects a significant loss of cotton seed production. So, during these stages of the crop, these chemicals should be sprayed. Cotton is an indeterminate crop, so its particular growth stage is complex to describe. Although, time gap between two consecutive stages also depends on the factors like date of sowing, soil texture, rainfall, air temperature and stresses., but 70-80 days after sowing, researchers considered a good time for these chemicals to be applied. Only one foliar spray application is appropriate.

Table 2: Time of application

Chemical	Time of application (DAS)	Number of sprays
Salicylic acid	70-80	1
Glycine betaine	70-80	1

