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Review Article

# PHYSIOLOGICAL DISORDERS IN SOLANACEOUS AND BULB CROPS: A REVIEW

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**Abstract-** The physiological disorders of solanaceous vegetables and bulb root crops are abnormalities in fruit crop, bulb morphology, colour, or both, which are not caused by infectious diseases or insects. The fruit and bulb abnormalities occur as a result of environmental stress on the plant growth. Physiological disorders which may include genetic, environmental factors, nutrition and cultural practices such as watering training and pruning practices. The physiological disorders study included blossom end rot (BER), splitting, abnormal fruit shape sprouting, bolting in garlic and tip burning, thick neck, blast, sprouting, sunscald, premature bulb, bolting, splitting and watery scales, chemical injury and freezing injury in the onion.

**Keywords**- Physiological disorders, Garlic

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## Introduction

The fruit and vegetable crops are still alive after harvest, and continue their physiological movement. Physiological disorders take place as an outcome of mineral deficiency, low or high temperature injury, or unwanted environmental conditions, such as high humidity. Physiological corrosion can also occur spontaneously owing to enzymatic activity, foremost to over ripeness and senescence, a simple aging happening [1]. Any deviation from the normal behaviour of the plant is known as disorder, which is caused either due to the deficiency or excess of any of the nutrients essentially required by the plant for its normal growth and development or due to exposure of the plant to any of the factors i.e. nutritional, environmental and cultural, in suboptimal or supra-optimal range [2]. Separately from living organisms, there are a number of non living factors that contribute disorders of vegetable crops. These are the biotic factors such as environmental extremes, nutrient deficiencies and toxicities, damage crop production steps, soil and water conditions [3]. The crop disorders are caused by non-pathological disorders such as poor light, weather damage, water-logging, lack of nutrients, and affect the performance of the plant system. Physiological disorders are renowned from plant diseases caused by pathogens, *viz.* as virus or fungus. Although the symptoms of physiological disorders may show disease-like, they can usually be prevented by varying environmental conditions. However, once a plant shows symptoms of nutrient deficiency it is likely that that season's yields will be cheap. Several abiotic disorders very limited research work has been done, and the causes are poorly understood both in terms of vulnerability and why certain environmental factors influence the parts of the plant. The vegetables growers suffers concerned with the incidence of abiotic disorders as these cause considerable economic loss. In view of the control of these abiotic for profitable production of vegetable disorders is required.

## Peppers (Bell pepper and hot peppers)

### Abnormal Fruit Shape

Faulty pollination and fertilization cause abnormal shape of pepper fruits. The faulty pollination may be due to injury caused by insect, or low or high temperature to the stigmatic portion. One side ovules get fertilized but other side not. Seeds in fruit are the sources of auxins synthesis. On one side where the seed content is high, the fruit growth will be more and on other side where the seed content is less, the fruit growth will be poor. This difference in growth makes the fruit shape abnormal. This condition generally occurs more when the crop is grown at a temperature lower than optimum required for normal pollination and fertilization [4].

### Blossom End Rot

Blossom end rot is caused by a localized calcium deficiency in the fruits [5]. Not only calcium, but also excessive moisture in the soil makes the calcium unavailable to the plant. On the other hand, water deficit condition also reduces the calcium uptake by the plant. Due to deficiency of this salt, the blossom end portion becomes sunken, brown to black in colour, thick and leathery. Larger fruited varieties are more susceptible to this disorder [2]. The likelihood is minimizing of BER takes a concentrated effort to reduce the conditions and that predispose pepper crop to BER. Calcium (Ca) moves in the water for the plant; the grower will might decide on increasing the level of irrigation instead of applying more Ca fertilizer. Nitrogen fertilizers should not be supplied in excessive amounts. High nitrogen rates, whether from chemical fertilizers or excessive

manure applications, will go in front to proliferation of leaves and branches of the plants. Plants with the unnecessary vegetative growth would be most likely to suffer from Ca deficiency in the fruits [5]. The BER is the best controlled by providing sufficient water to avoid water stress. Soil amendments such as lime or calcium fertilizations have been helpful in falling the incidence of disease in some conditions other than successful grades are sporadic. Similarly, the applications of foliar sprays of calcium salts have given unpredictable results [6].

**Sun scald**

Sunscald often occurs when plants lose leaves from foliar diseases or from sudden pruning of the plant canopy. The fruits after attaining mature green stage if exposed to high intensity light become susceptible to tissue damage. Initially sun exposed portion becomes white due to chlorophyll disappearance and later it is converted to black colour. Only a 10 minutes exposure to intense sunlight is enough to cause this damage if the temperature of sun-exposed tissues rises to 50°C. The affected area is light-colored, soft and wrinkled. The damaged tissue eventually turns whitish-tan and papery in texture Sunburned skin is often subsequently attacked by secondary fungi and bacteria, which then contribute to further decay [6]. Bell pepper has been found more susceptible to this disorder than hot pepper [7]. A combination of direct heat injury to fruit tissues and generation of super-oxide by the actions of sunlight on chlorophyll in the presence of high temperature causes sunscald. Fruits become more susceptible to this disorder at mature stage when the color turns from green to red. Control leaf diseases with pesticides to prevent leaf drop, which exposes fruit to sun, or make a shading frame that dapples the sunlight.

**Bulb crops**

**Garlic**

**Sprouting**

Sprouting of cloves occurs mostly towards the start of maturity, particularly when rain or excessive soil moisture and supply of nitrogen follow a dry spell. The loss due to this disorder in the field is never observed more than 0.5%. Varietal difference, spacing and early planting may be the possible causes of sprouting. White cultivars are more susceptible to sprouting than pink/purple varieties [8].

**Bolting**

In garlic, the induction of bolting does not occur in storage, however, differentiation is stimulated after planting by relatively low temperature and short photoperiod. In some cultivars, low soil temperature during growth may initiate bolting. Storage of cloves below 2°C temperature causes induction of flowering after planting in the field. Poor plant growth, low moisture supply and nutritional stress limit seed stalk induction. However, bulbing also tends to suppress stalk elongation.

**Onion**

India is one of the largest producers of onion in the world and second in China and, accounting for 16 percent of world area and 10 percent of the production area in India. The increasing its production from 1.04 million tonnes in 2000 to 4.08 million tonnes in 2009 from an area of 395500 ha [9]. In India, it is one of the most essential important vegetable crops of our country and forms a part of daily go on a diet in almost all households. The onion bulbs are normally stored from May to November used for a period of four to six months. The 50-90 percent storage losses are observed depending upon genotype and storage surroundings. The fatalities are comprised of physiological loss in weight (PLW) i.e. moisture loss and shrinkage (30-40%), rotting (20-30%) and sprouting (20-40%) could be minimized by harvesting at the right time, proper curing of onion bulbs and consequent storage at the required temperature and humidity conditions [10].

Normally, the rotting losses are at peak stage in the initial months of storage, particularly in June and July, when high temperature tied with high humidity outcome the losses. However, the proper grading and selection of quality bulbs and good ventilation conditions can reduce the rotting victims. The sprouting losses are usually recorded at the end of storage period or when exposed to high temperature of humid air. Moderately, more sprouting losses are observed in dark red and white onion cultivars than the light red onion cultivars.

**Tip Burning**

Tip burn is a kind of necrosis at the margins of young developing leaves. The susceptibility to tip burn is genetically governed, but influenced by environmental components. Tip burn may be promoted both by factors causing luxuriant vegetative growth. The principal cause of tip burns in the onion is the deficiency of potassium in the tips of onion leaves. The other factors responsible are increased light intensity coupled with high temperature, high soil pH and repeated use of brackish water [11].

**Blast**

When tender and succulent foliage of onion is exposed to scorching sun in the presence of high temperature and low atmospheric humidity, the foliage tips are burnt and later, this period if followed by heavy rains and cloudy weather, favors the development and spread of this blast disease. The older leaves are affected first than the younger ones. Due to the attack of this disease, the leave turn brown in color and thereafter they are dried. The drying of onion tip may also occur when the crop is raised in soils having salts towards higher side or brackish water is used for irrigating the crop. The salts reach the growing tip due to transpiration pull and cause burning of the growing tips [2].

**Thick Neck**

Any factor that keeps the plants into vegetative phase without forming bulbs or delays bulbing causes thickening of neck. Sometimes the onion plants fail to start bulbing and keep on their growth continued under certain conditions. Excessive growth without forming bulbs leads to thick-necked bulbs. Onion forms bulb more quickly at higher temperature. The plants can be kept in vegetative phase without forming bulbs at low temperature coupled with short days. For bulbing, plants need long days and high-temperature. The prolonged low temperature at bulbing stage increases thickening of neck. Excessive use of nitrogenous fertilizer will produce bulbs with thick neck [10]. Late maturity due to cool summer results in bulbs with a thick neck. This problem is always found associated with high yielding varieties in order to make sufficient leaf area for higher yield. Therefore, these varieties have to keep their growth continued.

**Premature Bulbing**

Premature bulbing is the start of bulb initiation very rapidly, soon after transplanting of seedlings in the field. This occurs when the seedlings are transplanted too late in the season; at this stage photoperiod and temperature both are favourable for bulbing but not for vegetative growth. High temperature and long day conditions are favourable for bulbing but not for vegetative growth. Seedlings when transplanted under such conditions will start bulbing without attaining sufficient growth. Late planting of over wintered seedlings leads to premature bulbing. Dense planting or too high plant population per unit area also causes premature bulbing in onion [11].

**Splitting**

Bulb splitting occurs due to the presence of multiple growing points in a single-bulb and also said to be associated with the genetic makeup of a cultivar. Splitting or doubling of bulbs also takes place under some adverse conditions and imbalanced nutrition. High temperature and short day conditions encourage the development of lateral shoots. Any kind of injury to the plants during cultural operations may lead to splitting of bulbs. A long water stress period at initial growth stage or a long drought spell followed by irrigation or rain is responsible for doubling of bulbs [10]. The use of un-rotten animal dung and urine in the field also leads to splitting of onion bulbs. Deep planting of onion seedlings reduces bulb splitting.

**Sun scald**

Sunscald generally occurs when the onion bulbs are left in the field for curing after harvest. However, sometimes it may occur even before harvest in the standing crop, when onion bulbs are out of the soil either due to their large size or due to shallow planting of seedlings. This disorder usually develops when the

temperature is very high, and humidity or soil moisture is excessively low. Under such conditions, the tissues directly exposed to sun become soft and slippery. In standing crop to avoid this injury the sun exposed bulbs may be covered with soil by earthing up operation. The field should be provided with irrigation at short interval to keep the soil and bulb temperature low, and seedlings should be planted little bit deeper into the soil to avoid exposure of bulbs to direct sun during development phase. After harvest, the bulb should never be left in the field [12].

**Bolting**

It is the most a serious disorder of onion crop. It refers to the emergence of seed stalk previous time of their formation and adversely affects the formation and development of bulbs. The bolting is an undesirable character, which could be due to directly, affects the bulb yield of onion [13]. Genetic factors, poor quality seed, photoperiod, change in temperature and cultural practices affecting the growth govern this process. Due to bolting weight of the bulb is reduced and the woody stalk of the inflorescence remains at the core of the bulb which reduces the quality of the bulb and dehydrated products [10]. Onion seeds if sown too early in the season and seedlings complete their basic vegetative phase (juvenile phase) before the fall in temperature will receive sufficient cold stimulus from atmosphere to synthesize flowering hormone and promote bolting. A week exposure to chilling temperature optimum for flowering, followed by long photoperiod will favour the development of seed stalks rather than rapid bulbing [14]. Very high nitrogen doses suppress bolting in the onion bulb crop. Bolting increases with an increase in size of the sets used as planting material [15]. Always sow the seeds at the proper time. Use of over fertilizer should be avoided. Adjustment time for transplanting in such a way that the crop may be exposed to moderate temperature at bulbing. The rabi crop is mature for coincides with high temperature compared to kharif crop. Growing non-bolting varieties like Early Grano, Texas Early Grano, etc. Transplant healthy seedling for 6 to 7 weeks old. Supply of the recommended dose of nitrogen and cuts the seed stalk at early stage [13].

**Watery Scales**

The symptoms are the development of thick and leathery outer most skin. Fungi or bacteria may infect these scales; however, the attack of these bacteria and fungi is not the sole cause of this disorder. Onion is sensitive to high levels of carbon dioxide, either that is present in internal scales or in the external atmosphere when the onions are stored in controlled atmosphere storage. If the carbon dioxide concentration exceeds 13%, it results in development of watery scales. In controlled atmosphere storage, carbon dioxide about 10% causes an internal breakdown. The higher concentration of carbon dioxide in the storage is more harmful to onions than low oxygen atmosphere [9]. Proper storage facilities should be maintained for storing the onions [16].

**Chemical Injury**

Chemical injury, known as alkali scorch, generally occurs when onions are stored in storage. This develops due to alkali impregnated/printed jute bags used to pack the onion bulbs. Higher concentration of ammonia gas in storage sometimes may cause serious injury to the onion bulbs. Ammonia injury is also same as that of injury caused by printed alkali material. The symptoms of ammonia injury are the development of dark brown to black spots.

**Freezing Injury**

The sensitivity of onion bulbs to freezing injury depends on the genetic makeup of a cultivar. The cultivars having very high total soluble solids are not found sensitive to freezing injury because the bulbs of such cultivars have a very low freezing point. The sensitivity of onion bulbs to freezing injury depends also on water content. The bulbs with less water content have more resistance against freezing injury. Many varieties could be stored successfully without any freezing injury, even at –2°C temperature, although below this temperature, the freezing injury is developed. Management of freeze and frost injury are usually done by cultivating the fields, if such an occasion is anticipated. Cultivating fields outcome layer of moist soil at the surface that acts as insulation. This holds the day's warm the soil around the bulb and root crop. The downside to refining the possible increase of the disease caused by throwing up contaminated soil on tender onion tissue [9].

**Conclusion**

The change in climate is affecting the incidence of physiological disorders in vegetable crops, particularly Solanaceous and bulb crops. Therefore, it is necessary that the growers or farmers should learn to identify the various physiological disorders that occur in their agro-ecological zones or areas and should be able to manipulate the environment and use locally available resources to control the particular disorders. Evaluating the cultivars suitable to the different agro-ecological zones/ areas along with manipulating sound horticultural practices can check the devastating effects of physiological disorders in these crops.

**Conflict of Interest: None declared**

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