MAJOR PHYSIOLOGICAL DISORDERS OF TOMATO AND THEIR MANAGEMENT

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ABSTRACT

Physiological or a-biotic disorders are mainly caused by changing environmental conditions such as temperature, moisture, unbalanced soil moisture, inadequate or excess of certain soil minerals, extremes of soil pH and poor drainage. The distinction between physiological or abiotic disorders from other disorders is that they are not caused by living organisms (viruses, bacteria, fungi, insects, etc.), but they are the result of abiotic situations (inanimate) i.e. their agents are non-living in nature which causes deviation from normal growth. They results in physical or chemical changes in a plant which is far away from what is normal and is generally caused by an external factor. Physiological disorders encountered in this paper included blossom end rot (BER), catface, cracking, internal white tissue, irregular ripening, puffiness, pox and fleck, rain check, zippering and sun scald.

KEYWORDS: Physiological, A Biotic, Genetic, Puffiness and Zippering

Vegetables often attract the consumers for their medicinal properties and also their aesthetic properties i.e., texture, colour, flavor and high water content. Therefore, vegetable showed relatively high metabolic activity when compared to other plant obtained foods as seeds. Compression to other crops like, fruit, cereals, pulses, oil etc the vegetable production increases quickly. This increase of production in vegetable crops is due to use of improved varieties, improved facilities for crop production and also use of improved technology for post harvest management. The morphological and quality of vegetables that we consume is highly influenced by both biotic and abiotic factors, which includes improper pollination or fertilization, hormonal imbalance, deficiency or excess of mineral elements, lack of nutrients, injuries due to high or low temperature, high rainfall, poor light, water logging or water scarcity and phyto-toxic compounds. In vegetable, sometimes more than one factor may be responsible for physiological disorder. Almost all major vegetable crops are prone to various types of physiological disorders that effecting different plant organs thus rendering them unfit for human consumption, therefore control of disorder is essential for profitable production of the crop.

Physiological disorders refer to the breakdown of tissue that is not caused by either invasion by pathogens (disease-causing organisms) or by mechanical damage. They may develop in response to an adverse pre-harvest and/or postharvest environment, especially temperature, or to a nutritional deficiency during growth and development. Physiological disorders are mainly caused by changing environmental conditions such as temperature, moisture, unbalanced soil nutrients, inadequate or excess of certain soil minerals, extremes of soil pH and poor drainage (Jarvis & McKeen, 1991; Khavari–Nejad et. al., 2009). This involves the genetic factors also. Thus there is a genetic (G) and an environmental (E) interaction (G x E). This complex interplay of factors is poorly understood for most disorders and in some cases contradictory results have been reported apart from numerous names for many disorders (Peet, 2009). These disorders may be developing during at growth and development stage, storage or in transit thus render the produce unmarketable. Some important examples of physiological problems in vegetable crop are blossom end rot of fruit (leather like decay of the blossom-end of several vegetable fruits associated with calcium deficiency). Secondary growth of potatoes and bolting of many biennial and perennial crops (a pre-mature flowering that occurs when the crops are exposed to inappropriate day lengths or temperatures). Secondary growth of potatoes and bolting of many biennial and perennial crops (a pre-mature flowering that occurs when the crops are exposed to inappropriate day lengths or temperatures). Other disorders that effect the economical production of the crop are sun scald, puffiness, cat face, growth cracks and blotchy ripening (tomato) low temperature during developmental phase and after harvest also render the produce unfit for market. Therefore, increased production of vegetables will have significance provided they reach the consumer in good condition, that is without any blemish or misshapen, this can be possible only when they are grown under adequate and balanced nutrition essential for sustaining crop productivity.

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Tomato

Internal White Tissue

Fruit affected by this disorder usually show no noticeable symptoms. When ripe fruits are cut, white hard areas especially in the vascular region are present in the outer walls of fruit (Olson, 2004). This disorder is more common; when fruits are ripen on the plant. Most tomato fruits produced almost all world are ripened on the plant. Under severe (hot climate) conditions fruit may also exhibit white tissue in cross-wall and center of fruit. High temperatures during the ripening period in the field seem trigger the symptoms. The problem may be reduced by adequate potassium fertilization (Imas, 1999; Olson, 2004 andPeet, 2009) but may not eliminate it. Some varieties are more resistant to the problem, especially the high colored varieties (Olson, 2004).

Watery Fruit

The main reason of this disorder is imbalance between ambient climate condition and plant water absorption of plant (Doraiset. al., 2001). This disorder is mostly develops after over-irrigation under a situation, where the strong root system develops by plant, which enhance the elevated root pressure. This results massive influx of water into fruits and increases the volume of tissues and some time damages the cell of fruits. This massive influx reduces the self life as well as their organoleptic quality of the fruits. Maintaining leaf area index at a reasonable level during summertime, which helps to reduce root pressure and minimize the incidence of this disorder (Doraiset. al., 2001).

Sunscald

This disorder can cause serious damage to fruit especially during the very hot South African (Sakata, 2009). Tomato fruits nearing maturity when exposed to the sun are prone to scald. Symptoms of this disorder include bleached patches on green tomato fruit accompanied by rapid desiccation, which leads to sunken areas, which usually has white or grey colour in green fruit or yellowish in red fruits.In India this is a serious problem in the month of May and June, will expose fruits to sunlight and increase chances for sunscald. The situation is aggravated when there is insufficient leaf cover, trellising and susceptible varieties (due to certain genetic predisposition). This disorder may be controlled by avoiding any factor that causes leaf loss, such as diseases, insects and abiotic factors i.e., hail damage may be also be responsible for the problem. Control measures should be aimed at avoiding leaf loss by whatever environmentally friendly means possible.

Puffiness

Puffiness refers to the existence of open cavities between the outer walls and the locular contents in one or more locules (Grierson & Kader, 1986) and is also known as hollowness or boxiness. When cut, cavities may be present that lack the normal "gel" and the fruit as a whole is not as dense. Puffer fruit are not appreciated by consumers, because they lack gel in the locules and do not ship well, because of their relative softness. The quantity of fruit affected is determined by genotype and growing conditions that result in incomplete pollination, fertilization, or seed development often as a result of cool temperatures that negatively impact fertilization. This problem is caused by any factor that affects fruit set, including inadequate pollination, fertilization or seed development (Olson, 2004). Too high or too low temperatures are common causes of this problem, high nitrogen and low potassium can also lead to puffiness.

Raincheck

Rain check physiological disorder can be described by tiny cracks that develop on the shoulder of the fruit. These cracks can vary from a few to complete coverage of the shoulder. The cracks feel rough to the touch, and affected areas can take on a leathery appearance and not develop proper color as fruit ripens. The ripe fruit is not affected, but green fruits are most susceptible, followed by breakers. Mostly damage occurs quite often on exposed fruit after rain, however the exact cause is not known, but appears to be related to exposure of fruit to water (Olson, 2004). The problem is more severe when heavy rains occur after a long dry period. Rain check can be alleviated by use of resistant cultivars with good leaf coverage, which protect fruit from rain or poor irrigation scheduling.

Zippering

Zippering disorder can be described as a fruit having thin scars that extend partially or fully from the stem scar area to the blossom end (Olson, 2004), the scar transverses the longitudinal section. Occasionally open holes in the locules accompany the zipper scar. Some people feel that a zipper is formed when the “blooms” stick

to the fruit and do not shed properly but this may interfere with proper fruit development and cause subsequent damage (Olson, 2004). Good cultural practices, which avoid fruit stressing and use of less susceptible cultivars can alleviate the problem of zippering

Zebra Stripe

Zebra stripe can be describing as a series of dark green spots arranged in a line from the stem end to the blossom end (Olson, 2004), the spots may coalesce resulting in elongated markings. The problem is genetic in nature as shown by the fact that it is variety related. It is probably a genetic defect that only develops under certain environmental conditions and may be linked to pox and fleck (Olson, 2004).

Tomato Irregular Ripening

Tomato irregular ripening (TIR) is a physiological disorder, which occurs on tomato fruit due to silver white fly (Bemisaargentifolii), because this fly fed upon the tomato plants (Olson, 2004). Symptoms of this disorder appear as uneven color as fruit develops rather than appearing on the leaves that are fed on. Plants infested with silver white fly can develop with external longitudinal white or yellow streaks resulting in unmarketable fruit. Internal symptoms are characterized by lack of internal coloring of the fruit, resulting in reduction of postharvest quality. The mechanism underlying tomato irregular ripening are not fully understood, however control can be achieved by preventing silver white fly from feeding on tomato plants.

Gold Spots/Specks

Gold specks are characterized by tiny yellowish or golden spots, which are regular and often observed around the calyx and shoulders (De Kreij et. al., 1992). Gold specks are shown to be cells containing some granular mass of minute calcium oxalate crystals (De Kreij et. al. 1992; Den Outer & Van Veenendaal, 1988). Possible causes of gold spot/gold speck include excess fruit Ca and or high Ca/K ratios (Imas, 1999), high P, high relative humidity and high average temperature. The presence of gold specks affects the aestheticappearance of tomato fruit (Goossens, 1988) and reduces their subsequent shelf life. Possible control measures include preventing excess Ca uptake.

Pox

Pox is described as small cuticular disruptions whose number can vary from a few too many found at random on the fruit surface (Olson, 2004). Severely affected fruits are not marketable and thus contribute to postharvest losses of tomato. The real cause of pox is not clearly understood. However, the condition seems to be genetic in nature (Doraiset al., 2001; Olson, 2004) but are difficult to breed out of a variety since the disorders only show up under certain environmental conditions (Olson, 2004). Differences of opinion exist as to the real conditions or genetic makeup lead to susceptibility to pox.

Fruit Cracking

Different types of fruit cracking problem have been observed in tomato fruits: radial cracking (star shaped & originating from the peduncle), fruit bursting, concentric cracking (circular cracks originating from the peduncle) and cuticle cracking also known as russeting (Peet, 1992; Peet& Willits 1995; Doraiset al., 2001; Olson, 2004; Kennelly, 2009).Normally fruit cracking in tomato occurs due to rapid growth of fruits in the abundance of water and high temperature, especially when these conditions prevail following periods of stress. Cracking of fruits is mostly associated with rapid movement of water and sugar towards the fruit when cuticle elasticity and resistance are weak, this disorder generally seen six to seven weeks after fruit set. The imbalance between water supply and water loss has been one reason for fruit cracking. Fruit cracking disorder can be controlled by using the cultivars that are less prone to cracking, provision of even water and balanced nutrition (Kennelly, 2009). The cause of this disorder is under genetic control. Some of the preventative measures include avoiding large variations in water availability in the soil. Sudden water availability; cause too rapid fruit expansion resulting in subsequent fruit cracking. Limiting fruit exposure to sun through foliar disease management, proper trellising and staking have been reported to alleviate this problem, Some studies have reported that the application of Ca and gibberellins lessened the problem (Larson et, al., 1983; Peet, 1992).

Blossom End Rot (BER)

The symptoms of blossom end rot start out as a small spot, which grows larger and darker with fruit growth. Blossom end rot can most easily be identified by a

discolored, sunken spot at the blossom end of the fruit (Vanderlinden, 2009). Blossom end rot has water soaked spots, which enlarge and can cover up to half of the fruit or even whole fruit. The tissue turns light to dark brown. The spot then dries out and becomes leathery. It may be infected by secondary pathogens.Blossom-end rot occurs when fruit is one third to one half fully grown. Fruit affected by blossom end rot ripens prematurely resulting in inedible fruits.The disorder usually affects the first few fruits of tomatoes growing in cold soils. Blossom end rot is caused by Ca deficiency in the fruits. When a plant does receive inadequate water or when there is excess water in the soil, a plant's capabilities of absorbing Ca are diminished. The disorder is usually most severe following extremes in soil moisture (either too dry or too wet). These conditions result in a deficiency of Ca available to the maturing fruit, at the spot, where damage becomes apparent (McLaurin, 1998). Cause of injury is due to localized Ca deficiency, which occurs during a critical phase of fruit growth. Possible control measures include adding Ca to fruit by sprays. For avoiding ion imbalance in soil and fluctuations in soil moisture and water logging, it is recommended to avoid root pruning during cultivation and to grow tomatoes on the ground rather than on trellis, Use of less susceptible cultivars has been advised. Providing even and adequate soil moisture, especially during fruit set has been reported to reduce the incidence of BER (Kennelly, 2009). More uniform soil moisture may be achieved by adopting a balanced irrigation programmers and mulching to conserve moisture. Avoiding over fertilization of the plant with N, especially of the ammonia formulation and selection of cultivars that are less prone to BER have been reported as possible means of avoiding the disorder (Kennelly, 2009).

Misshapen Fruits

Poor fruit setting and misshapen fruits in tomato is due to low temperature.

Cat Face

Cat face is a disorder characterized by gross deformity of tomato fruit, which usually renders them unmarketable. The defect is usually located on the blossom end of the fruit. The deformity is caused by something (internal & external) that occurs during the formation of the flower that results in the fruit not developing normally (Olson, 2004; Peet, 2009). Catface is commonly observed in first harvest fruit. The symptoms include enlarged scars and holes in the blossom end. Extreme heat, drought, low temperature, and contact with hormone-type herbicide sprays may cause flower injury. There is not much that can be done for control. Delayed pruning, balancing the internal nutrient, regulating temperature, the assimilation rate, and the endogenous growth regulators can control cat facing.

Herbicide Injury

This herbicide injury is caused by more application of 2,4-D, MCPP and other growth regulators. Plants are very sensitive to these chemicals throughout the growing season. The first symptom is downward curling of leaves and tips of growing points. Leaves often become narrow and twisted toward the tip, with prominent, light-colored veins.The symptoms are most pronounced on portions of the plant that were actively growing when the exposure occurred. In severe cases, stems and petioles become thick, stiff, and brittle with warty outgrowths. Affected plants usually recover. However, the fruit may become catfaced or develop in a plum shape, and may be hollow and seedless. To avoid herbicide injury, do not spray when wind may carry spray drift toward tomatoes or other sensitive crops. In addition, spray at low pressures, use a coarse-spray nozzle, apply the spray as close to the ground as possible. Avoid applying other pesticides in sprayers that have previously contained herbicide because traces of herbicide are likely to remain in the sprayer even after thorough rinsing.

Blotchy Ripening

This disorder is also known as graywall. It is recognized as grayish appearance caused by partial collapse of the wall tissue; hence the term graywall (Olson, 2004). In this case greenish yellow and whitish patches appear on ripened fruit, particular on the stem end portion sometimes white or brown tissues are present in blotched area. The affected areas remain green or yellow are usually found nearly at the stem end of the tomato fruit. Symptoms include irregular areas on the fruit with lack of red colour. Cultivar differences low K, high N (Imas, 1999), low temperature and low light intensity and excessive soil moisture are among causal factors. This disorder may be controlled by avoiding conditions previously described as causal factors.

CONCLUSION

Plant nutrition in relation to growth and development continues to be a major area of study in vegetable crops. With rising awareness of the importance of fruit components, such as antioxidants and vitamins, for human health greater importance is now placed on the nutritive value of produce, as well as on the molecular basis of mechanisms implicated in the uptake and utilization of inorganic nutrients by the plants. In a comparative review of the Solanaceae, it is unavoidable that given its greater importance as a crop, tomato has been researched much more than pepper or eggplant.

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