

NaCl and Cd stress effect on shoot growth of potato cultivar

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Abstract

Plants are affected by both biotic and abiotic stress. Abiotic stresses are the major environmental constraints that affect negatively the productivity and growth pattern of the crops all over the world. A similar pattern of suppression of growth is seen in the study conducted. The Kufari Pushkar variety of *Solanum tuberosum* plant is taken for the study of the effect of salt and cadmium on length of shoots grown indoors in the laboratory. The plants are grown in artificial growth chamber in pots maintaining the required temperature and humidity which is appropriate for the growth. The heavy metals and salt are given in dissolved form using Hoagland's solution which support the growth under normal and stressed conditions. The pots were placed under the cool fluorescent light ranging from 400 nanometers to 700 nanometers for four to five hours daily defining the normal photoperiod necessary for the plant growth. A total of ten sets of treatments were used as 50mM, 100mM, 150mM of salt, 0.5mM, 1mM, 2mM of cadmium and 0.5mM+50mM, 1mM+100mM, 2mM+150mM of combined stress of the salt and cadmium. All the set were compared with control for shoot lengths. At very low concentration of cadmium (0.5mM) the shoot length was increased even more than control itself. It was

concluded from the experimental study that the a small level of heavy metal Cd support the growth of plant weather given as single with 50 mM salt. But both 150 mM salt and 2mM Cd+150 NaCl given in combination affects the overall growth of plant negatively.

Keywords:

Cadmium stress; Salt stress; Shoot growth; Hoagland's solution; potato

Introduction

Soil salinity is a major constraint to vegetable and fruit plants because it limits crop yield and restricts use of land previously uncultivated. The ionic form of NaCl is toxic to plant (Amtmann, A. and Sanders, D. 1999). Saline environment is increasing regularly and harming many crop of India and other countries. *Solanum tuberosum* plant is largely being affected by NaCl stress. Cadmium is toxic heavy metal for plants. It effects negatively the growth and development of plants. Potato plant is affected by the heavy metal cadmium in India and large producer countries. Cadmium is non essential element released in to environment by human activities and is largely soluble in water. The dissolved form of this metal gets easily absorbed by field plants and cause antioxidants to decrease in their carbohydrate content. Salt also have the similar effect on the growth of plants.

Materials and Methods

Collection of Plant Material

The Kufari Pushkar variety of *Solanum tuberosum* were taken from certified potato seed storage.

Basic Information of Morphology and Location of Plant Variety

This cultivar was mainly developed in Kufari research station, Shimla. It is released in 1998.

The plants tall, semi-erect, medium compact and vigorous. Stems few, medium thick, green with moderately developed straight wings. The Leaflets ovate to lanceolate, smooth glossy surface with entire margin. The White, large, oval, slightly tapered, smooth skin, fleet eyes, yellow flesh. Parts of Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Uttar Pradesh & West Bengal. This variety is easy to cook, waxy texture, mild flavor, free from discoloration after cooking. Not suitable for processing purposes but resistant to early blight and moderately resistant to late blight.

Plant Growth Conditions

The tubers of Kufari Pushkar variety of *Solanum tuberosum* were selected for experimental study in pots during indoor growth. Just taking the tubers outside the cold storage tubers were kept at normal room temperature for 24 hours washed with 2% mercuric chloride solution and then planted in pots. The artificial photosynthetic active radiation (PAR) was marginal suppression till 1mM but 2mM Cd was strongly suppressive (Fig. 1).

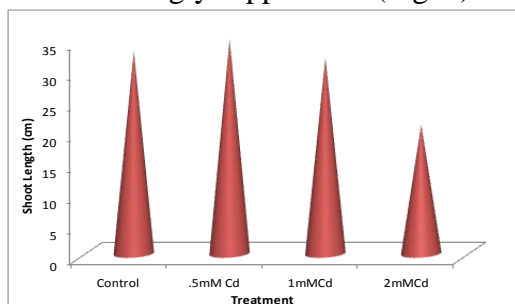


Fig. 1: Effect of Cadmium stress on shoot growth of Kufri Pushkar potato

supplemented by cool fluorescent light with 400-700(nm) nanometer wavelength. Daily 4-5 hours photoperiod was provided for photosynthesis and development of plant. Total ten treatments were selected out of which three were of cadmium (0.5mM Cd, 1mM Cd, 2mM Cd), three of salt (50mM NaCl, 100mM NaCl, 150mM NaCl), three of combined stress of cadmium and salt (0.5mM Cd.+50mM NaCl, 1mM Cd +100mM NaCl, 2mM Cd+150 mM NaCl) with one as control. The cadmium and salt were given to plant in Hoagland solution for better absorption. The Hogland solution also provided nutrients to tubers which helped in growth against stressed conditions.

Growth Analysis

After 15 days of growth, plant height was measured with ordinary scale. First a support was provided to plant for making it erect. The scale was taken just above the eye of the tuber of Kufari Pushkar variety and then height was measured in centimeters, followed by comparison with the control. All treatments of salt and cadmium stresses were analyzed and compared.

Result

The response of potato to Cd, NaCl and combination stress showed that there was general decrease in shoot growth. The Cd stress showed no suppression at 0.5mM Cd, The NaCl stress was marginal at 50mM but strongly suppressed shoot growth at 100mM and 150mM (Fig. 2).

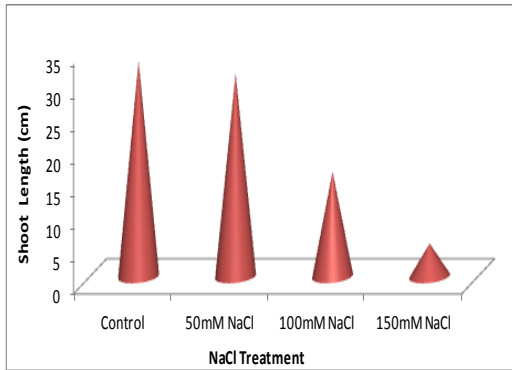


Fig. 2: Effect of NaCl stress on shoot growth of Kufri Pushkar potato

When applied in combination, the NaCl stress clearly dominated in its suppressive effects esp. at 100mM Na + 1mM Cd and 150mM Na + 2mM Cd (Fig. 3). The inhibition pattern resembled as that of only NaCl stress.

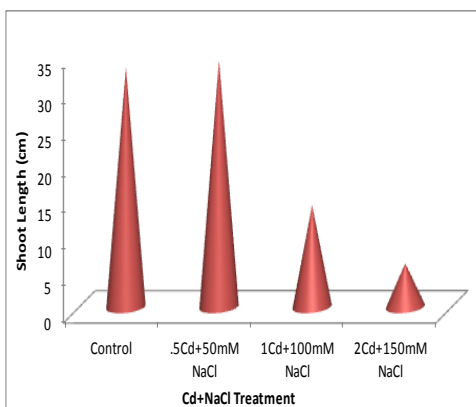


Fig. 3: Effect of NaCl + Cadmium stress on shoot growth of Kufri Pushkar potato

Discussion

The Kufri Bahar variety of potato was fairly resistant to Cd stress but very sensitive to NaCl stress. The low levels of Cd (0.5mM) and NaCl (50mM) had no effect on growth of this plant.

Conclusion

The salt affect the vegetable crops negatively and reduce the total output of the agriculture sector in India. Heavy metals like cadmium contaminate the soil in dissolved form from different industrial waste and remain for long in field soil which later affect the potato plant.

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