The Response of Tomato (Solanum lycopersicum L.) Seedling to Foliar Application of Cultar (Paclobutrazol) Under Controlled Conditions

Prepared by

Hisham Saeed, Husni Qteet, Ansam Melhem, Ramez Shtayeh, Saif Mansor

Supervisor

Dr. Tawfiq Qubbaj
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Introduction

- Tomato (*Solanum lycopersicum* L.) belongs to the Solanaceae family,
- considered as one of the most widely grown vegetable in the world, with a
  very high daily consumption compared to other vegetables.
- Tomato has being also recognized as a rich source of vitamins and
  minerals; 100 gm fresh tomato contains 3.5 gm carbohydrate, 0.98 gm
  protein, 0.50 gm β-carotene, 0.35 mg iron and 10-100 mg ascorbic acid
  (Rashid, 1993).
- It is also among the most important vegetable crops grown in Palestine.
- With an estimated area cultivated with tomato of about 8918 dunums every year producing about 82,739 ton (MOA, 2017).
- Cultar (is a very potent plant growth regulator)
- use on a wide range of fruit and vegetable crops
- the active ingredient of ‘cultar’ is a broad spectrum xylem mobile plant growth regulator.
- The mode of action of paclobutrazol is the inhibition of gibberellic acid synthesis in plants.
- The inhibition of gibberellin production by paclobutrazol results in slow cell division and elongation without causing toxicity to cells
- Besides reducing gibberellins level, PBZ increases cytokinin contents, root activity and C: N ratio
Use the cultar (paclobutrazol) in fruit trees (Mango) for manipulate flowering

The post-harvest application of a small amount of paclobutrazol to the soil significantly promotes flowering and fruiting.

- A significant increase in flowering leading to increased yield.
- The early flowering considerably enhanced fruit maturity.
- Treated trees flowered three to four weeks early, which reduced the time to fruit maturity by at least two weeks.
- Visually, the fruit developed a better external colour.
**Effect of cultar on vegetative growth**

- Stem: inhibition of cell elongation, reduce length of internodes
- Leaves: reduce size and volume, increase chlorophyll production

**Cultar is used on tomato plant especially in nurseries for some reason:**

- To balance between vegetative and root growth
- When climatic conditions become unstable, especially high temperatures, the rate of vegetative growth becomes high
- And another reason for the owner of the nursery to delay the transplant for some reason
Objective

- **General objective:**
  - Investigate the effects of Cultar (Paclobutrazol) plant growth regulator and optimizing the concentration application of vegetable seedlings.

- **Specific objective:**
  - Find out the effect of paclobutrazol application on seedlings growth Performance and Leaf Greenness with different concentration
  - Highlight the main parameters for identifying Paclobutrazol treated seedlings in commercial nurseries
Research question and identified problems.

- Depending on local nursery experience and observation:
- The current research is hypothesized that the application of cultar (Paclobutrazol) delays the growth of tomato seedling.
- Therefore our project aimed to define the effect of cultar and its symptoms of appearance and identify a visual parameters to confirm the application of cultar on seedlings.
Project Description and Methodology

- **Plant materials:**
  48 seedlings (5-7 day) old of tomato

- **Treatments:**
  - T1 = 200 µl/l
  - T2 = 150 µl/l
  - T3 = 100 µl/l
  - T4 = control water

- Prepare 0.5 l of the spraying solution by adding half the assigned amount of the cultar in 500 ml tap water.

- Fully spray the seedling with the spray solution once at the beginning of the experiment.
The experimental design

- The experimental design was a complete randomized design (CRD) with three replications for each treatment.
- Each replicate was consisted of 3 seedlings in one pot
- Mixed soil 50% and 50% beatmoos
Parameters

- The following parameters have been recorded after spraying with assigned concentration weekly:
  
  - **Growth performance (Morphological Parameters)**
  
  - **Plant height**
  
  - The seedling height from the soil surface to the top of seedling (apical marstem) was measured for 3 seedlings per Rep. using a **measuring tape** and averaged to represent corresponding treatments.
- **Stem diameter**
- The seedling stem diameter near the soil surface (crown area) was measured for 3 seedlings using a caliper.
- Leaf colour
- The leaf color of three seedling was measured using the colorimeter at the end of experiment (5 weeks after transplanting)
- The Hunter L (color lightness), a (position on the green-red axis) and b (position on the blue-yellow axis) values of leaf will be read using Colorimeter CR-400.
The leaf area

The seedling leaf area in (mm\(^2\)) will be measured with Area Meter AM350 for 3 leaves at the end of experiment.
Shoot and root fresh and dry weights
- At the end of the experiments the Leaf and shoot fresh and dry weights (g) were determined.
- Dry weight was measured after drying for 24 h at 105 °C.

Leaf Greenness Parameters
- Photosynthetic pigments chlorophyll was determined using chlorophyll meter (SPAD-502Plus), which is presented by SPAD value.
- Average of 3 measurements from different spots of a single leave will be considered.
Results & Discussion

1. Plant height

Fig 1. the effects of different concentration of 'Cultar' foliar application on tomato seedlings height

- The data were statistically analyzed using the analysis of variance and Duncan's multiple range test was used for the mean separation at 5% level of probability, using SAS software version 8.0

- Cultar application was found to significantly reduce the plant height in treated seedlings compared to untreated seedlings (Fig 1).
2. Stem Diameter

- Fig 2. the effects of different concentration of 'Cultar' foliar application on tomato seedlings diameter

- In the 200 µl/l cultar treatment stem diameter, was significantly higher than non treated seedlings (Fig 2)
3. Leaf Color

- Measuring color using Hunter L, a, b

- Hunter L, a, b and CIE 1976 L*a*b* (CIELAB) are both color scales based on the Opponent-Color Theory.

Fig 3. the effects of different concentration of 'Cultar' foliar application on tomato seedlings color

- This theory assumes that the receptors in the human eye perceive color as the following pairs of opposites.
  - L scale: Light vs. dark where a low number (0-50) indicates dark and a high number (51-100) indicates light.
  - a scale: Red vs. green where a positive number indicates red and a negative number indicates green.
  - b scale: Yellow vs. blue where a positive number indicates yellow and a negative number indicates blue.
4. Relative Chlorophyll Content

- The relative chlorophyll content was found to be significantly enhanced by ‘cultar’ application at later stages of seedlings growth (Fig 4).

- Fig 4. The effects of different concentration of ‘Cultar’ foliar application on tomato seedlings chlorophyll content by using SPAD Meter.
5. Root Fresh Mass

Fig 5. The effects of different concentration of 'Cultar' foliar application on tomato seedlings Root fresh mass
6. Shoot Fresh Mass

- Fig 6. The effects of different concentration of 'Cultar' foliar application on tomato seedlings Shoot fresh mass
7. Root/Shoot Ratio

- Fig 7. the effects of different concentration of 'Cultar' foliar application on tomato seedlings Root/Shoot ratio mass
Fig 8. the effects of different concentration of 'Cultar' foliar application on tomato seedlings Leaf area
Conclusions

- The paclobutrazol treated tomato seedlings were greener, more compact and have a better root system.
- Tomato seedlings treated with Cultar (Paclobutrazol) were superior in terms of increased photosynthetic characteristics when compared with untreated controls.
- The direct cause of the increase in leaf greenness and darkness of treated seedlings may be due to the increase in chlorophyll content.
Recommendation

- Further work is recommended for:
  - Investigate the impact of Cultar (Paclobutrazol) on tomato yield and production and fruit quality under greenhouse due to seedling treatments with cultar
  - Identify the time needed till the removal effect of Cultar (Paclobutrazol) on tomato seedlings in relation to growing season
  - Investigate the impact of Cultar (Paclobutrazol) on tomato plants (indeterminate varieties) yield and fruit quality under greenhouse as an alternative method of plant trellising
  - Investigate the impact of Cultar (Paclobutrazol) on controlling growth and influenced fruit characteristics of tomato
References

- FAO, 2016. FAO, Rome, Italy.