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# ALLELOPATHIC POTENTIAL OF HORSE PURSLANE (*TRIANTHEMA PORTULACASTRUM* L.) ON GROWTH AND DEVELOPMENT OF GREEN GRAM (*VIGNA RADIATA* L.)

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## Abstract

A pot culture experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli to evaluate the allelopathic potential of *Trianthema portulacastrum* L. on growth and development of green gram. The experiments were laid out in Completely Randomized Design (CRD) with six treatments and four replications. The treatment comprised of different concentrations of *Trianthema portulacastrum* both in whole plant and whole plant extract *viz.,* 1, 2, 3, 4 and 5% and control (no *Trianthema portulacastrum* whole plant and whole plant extract). The whole plant and whole plant extract of *T. portulacastrum* significantly affected the germination and seedling growth of green gram. The minimum germination percentage was observed 4 and 5% *T. portulacastrum*. However, maximum germination percentage was observed in control. There was continuous decline in germination percentage with increasing concentration of *T. portulacastrum* whole plant and whole plant extract. *T. portulacastrum* whole plant and whole plant extracts significantly inhibited the root length, shoot length, seedling length and SVI of green gram.

***Key words :*** Allelopathy, *Trianthema portulacastrum,* green gram, germination, seedling length, SVI.

## Introduction

The phenomenon of allelopathy, thereby a plant species chemically interferes with the germination, growth or development of other plant species due to release of chemicals. These chemicals are called allelochemical. Allelochemicals is derived from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes in both natural and agricultural systems (Rao, 2000).

*Trianthema portulacastrum* L. is a serious weed worldwide (Balyan and Bhan, 1986). It has become a noxious weed due to competition for yields in many crops like *Pennisetum glaucum* L. (millet), *Sorghum bicolor* L. (sorghum), *Zea mays* L. (maize), *Triticum aestivum* L. (wheat), *Vigna mungo* L. (mash), *Vigna radiata* L. (mung bean), *Cyamopsis tetragonoloba* L. (guar) and *Helianthus annuus* L. (sunflower) and causing significant reduction in the yield (Nayyar *et al.,* 2001).

*T. portulacastrum* have either positive or negative effects on the growth of nearby plants. Allelopathic growth inhibition of crop plants owing to *T. portulacastrum* has also been reported (Sethi and Mohnot, 1988). The weeds influence the crop plants by releasing phytotoxin from their seeds, decomposing residues, leachates, exudates and volatiles (Narwal, 2004). *T. portulacasturm* possess different allelochemicals. Hussain *et al.,* (1987) reported that *Trianthema portulacastrum* contains caffeic, chlorogenic, p-hydroxybenzoic, p - coumaric and ferulic acids which may inhibit or promote seed germination of other plants. Extent of allelopathic inhibition on germination and seedling growth of crops varies from weed species (Hamayun *et al.*, 2005) and its plant parts (Economou *et al.*, 2002; Aziz *et al.*, 2008).

Hence, the present investigation was carried out with the objective of evaluating the allelopathic potential of *T. portulacastrum* on growth and development of green gram (*Vigna radiata* L.).

## Materials and Methods

Pot culture experiment was conducted during 2017 at Anbil Dharmalingam Agricultural College and Research

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Institute, Thiruchirappalli to evaluate the allelopathic potential of *Trianthema portulacastrum* on growth and development of green gram. Pot culture studies were conducted in Completely Randomized Design with four replications. The treatments comprised of different concentrations of *Trianthema portulacastrum* both in whole plant and whole plant extract *viz.,* 1, 2, 3, 4 and 5 and control (no *Trianthema portulacastrum* whole plant and whole plant extract) on green gram. The variety used for the experiment was green gram VBN-2.

**Procedure for identification of allelopathic effect of *T. portulacastrum* whole plant**

Soil sample for potting media was collected from different areas following soil sampling techniques

↓

Collected samples were shade dried and processed into 60mm sieve size

↓

Simultaneously *Trianthema portulacastrum* was collected from the field, shade dried for about a week period

↓

It was oven dried for 2 days with 80°C in hot over oven.

↓

The dried *T. Portulacastrum* was chopped into small pieces

↓

Different concentrations of 1%, 2%, 3%, 4% and 5% of whole plant (W/W) were prepared and weighed and added to the pots accordingly

↓

For 1% concentration 10g added to 1Kg processed soil
For 2% concentration 20g added to 1Kg processed soil
For 3% concentration 30g added to 1Kg processed soil
For 4% concentration 40g added to 1Kg processed soil
For 5% concentration 50g added to 1Kg processed soil

↓

Irrigated the pots and allowed for decomposition for 2-3 days

↓

Green gram seeds (VBN-2) Were sown in the pots (15 seeds per pot) according to the nature of treatments (1, 2, 3, 4 and 5%) along with control (no *Trianthema portulacastrum* whole plant)

↓

Irrigated at 3 days interval

**Procedure for preparation of *Trianthema portulacastrum* whole plant extract**

Whole plant was taken and dried at room temperature

↓

Placed in hot air oven at about 80°C for 48 hours

↓

Chopped into pieces with the size of 1 cm

↓

It was taken out and grinded

↓

The powder was immersed in distilled water to get different concentration 1%, 2%, 3%, 4% and 5% of *Trianthema portulacastrum*

↓

For 1% concentration 1 g soaked in 100 ml distilled water
For 2% concentration 2 g soaked in 100 ml distilled water
For 3% concentration 3 g soaked in 100 ml distilled water
For 4% concentration 4 g soaked in 100 ml distilled water
For 5% concentration 5 g soaked in 100 ml distilled water

↓

*Trianthema portulacastrum* of different concentrations were soaked in water for a day

↓

These aqueous leachates were filtered separately and centrifuged at 12000 rpm for 5 minutes

↓

The different concentration of whole plant extracts of 1%, 2%, 3%, 4% and 5% were prepared

↓

Before sowing, the green gram seeds were surface sterilized with 0.1% mercuric chloride for 1 minute and then washed in distilled water 3 times for 1 min each

↓

Green gram seeds were sown on pots and watered at periodic intervals

↓

Extracts of *Trianthema portulacastrum* were added to the pots according to the nature of treatments (1, 2, 3, 4 and 5%) along with control (using distilled water) during every irrigation

### Observations recorded

• Germination percentage:

Germination count was recorded at 7 days after sowing (DAS). The germination percentage was calculated by using formula:

$$\text{Germination \%} = \frac{\text{No. of seeds germinate}}{\text{Total seeds}} \times 100$$

• Growth parameters:

The growth parameters *viz.,* root and shoot length were recorded at 15 DAS using a meter scale and expresses as cm. The seedling length was calculated by using formula:

Seedling length (cm) = Root length (cm) + Shoot length (cm)

• Seedling Vigour Index (SVI)

Seedling vigour index was calculated according to the equation of Abdul-baki and Anderson, (1973).

SVI = Germination percentage × Radical length (cm)

## Results and Discussion

### Allelopathic potential of *Trianthema portulacastrum* on green gram

**• Germination percentage:**

The results revealed that *Trianthema portulacastrum* whole plant and whole plant extract significantly affected the germination of green gram (Fig. 1). The whole plant and also whole plant extract of *T. portulacastrum* decreased the germination of green gram as compared to control. There was no germination was observed in the treatment received 4 and 5% *T. portulacastrum* whole plant. The treatment of seeds with 5% *T. portulacastrum* whole plant extract registered minimum germination percentage (25%). The highest germination percentages (96% and 87% in whole plant and whole plant extract, respectively) were recorded in control. However, there was decreasing germination percentage with the increasing concentration of *T. portulacastrum* whole plant extract. The increase in the concentration of *T. portulacastrum* whole plant and whole plant extract inhibits the seed germination of crop plants might be due to disturbance in activities of peroxidase, alpha-amylase and acid phosphates. This finding agreed with that of Alam and Islam, (2012).

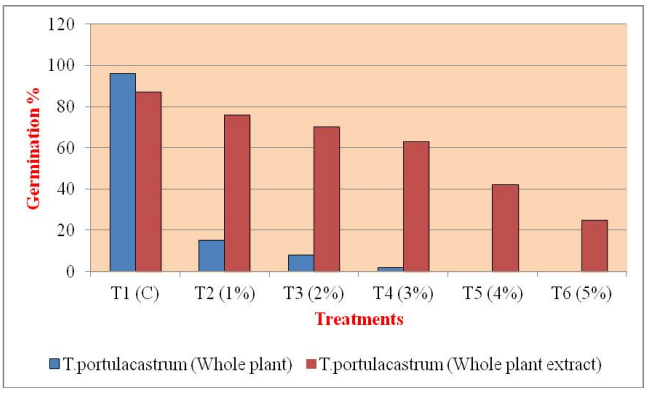


**Fig. 1:** Allelopathic effect of *T. portulacastrum* on germination (%) of green gram.

### Root length

The root length of green gram was significantly influenced by the whole plant as well as whole plant extract of *Trianthema portulacastrum* (Table 1). The highest root length (3.5 and 3.2 cm, respectively) was recorded in control. The treatment of seeds with 5% *T. portulacastrum* whole plant extract registered minimum root length (1 cm). However, there was decreasing root length with the increasing concentration of *T. portulacastrum* whole plant extract. This might be due to the root cell division is prevented by the phenolic compounds of *T. portulacastrum* which fall in line with the findings of Avers and Goodwin, (2000). Water soluble inhibitors could be the reason of reducing the root length. This is line with the findings of Kill and Yun, (2003).

**Table 1.** Allelopathic effect of *T. portulacastrum* on root and shoot length (cm) of green gram.

| Treatments | Root length (cm) | | Shoot length (cm) | |
|---|---|---|---|---|
| | Whole plant | Whole plant extract | Whole plant | Whole plant extract |
| $T_1$- Control | 3.5 | 3.2 | 9.5 | 14.0 |
| $T_2$ - 1% *T.portulacastrum* | 1.7 | 2.1 | 5.3 | 12.5 |
| $T_3$ - 2% *T.portulacastrum* | 1.2 | 2.0 | 3.6 | 12.0 |
| $T_4$ - 3% *T.portulacastrum* | 0.2 | 1.6 | 2.3 | 11.1 |
| $T_5$ - 4% *T.portulacastrum* | - | 1.3 | - | 9.8 |
| $T_6$ - 5% *T.portulacastrum* | - | 1.0 | - | 7.5 |
| SEd | 0.03 | 0.05 | 0.1 | 0.3 |
| CD (P=0.05) | 0.06 | 0.10 | 0.2 | 0.6 |

### Shoot length

The shoot length of green gram was significantly influenced by the whole plant extract and whole plant of *Trianthema portulacastrum* (Table 1). The highest shoot length (11 and 17 cm in whole plant and whole plant extract of green gram, respectively) was recorded in control. The treatment of seeds with 5% *T. portulacastrum* whole plant extract registered minimum shoot length (10.2 cm) and completely no growth of green gram was observed

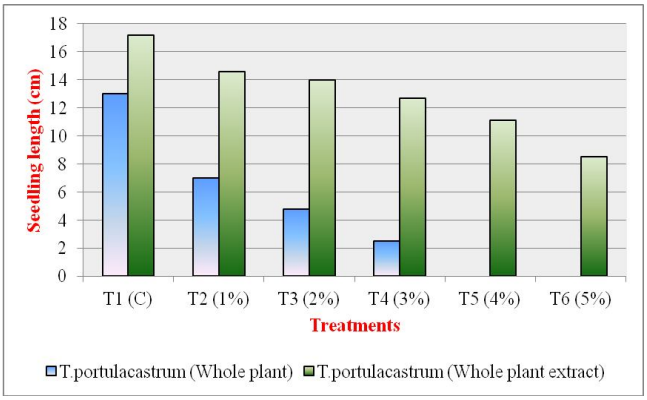


**Fig. 2:** Allelopathic effect of *T. portulacastrum* on seedling length (cm) of green gram.

with 4 and 5% *T. portulacastrum* whole plant. However, there was decreasing shoot length with the increasing concentration of *T. portulacastrum* whole plant extract. These results are in agreement with the findings of Bhuvaneshwari *et al.,* (2019). Cell division might have been affected, which reduce the shoot length of seedlings as allelopathic compounds are known to inhibit the functioning of gibberellin and indole acetic acid. This is accordance with the findings of Tanveer *et al.,* (2008).

### Seedling length

The seedling length of green gram was significantly influenced by the whole plant and whole plant extract of *Trianthema portulacastrum* (Fig. 2). The highest seedling length 13.0 and 17.2, respectively) was recorded in control. The treatment of seeds with 5% *T. portulacastrum* whole plant extract registered minimum seedling lengths (8.5 cm). However, there was decreasing seedling length with the increasing concentration of *T. portulacastrum* whole plant extract. This is in conformity with the findings of Hussian *et al*., (1987) and Bhuvaneshwari *et al.,* (2019).

### Seedling Vigour Index (SVI)

The SVI of green gram were significantly influenced by the whole plant and whole plant extract of *Trianthema portulacastrum* (Fig. 3). The highest SVI was recorded in control. The treatment of seeds with 5% *T. portulacastrum* whole plant extract registered drastic decrease in SVI. However, there was decreasing SVI with the increasing concentration of *T. portulacastrum* whole plant extract. Pre soaking in whole plant extract of *T.portulacastrum* showed minimum germination percentage indicating the likely presence of allelochemicals which might have reduced the vigour of tested crop seeds and germination process as reported by Meihua *et al.,* (2006). These results are in accordance with the findings of Tanveer *et al.,* (2008).

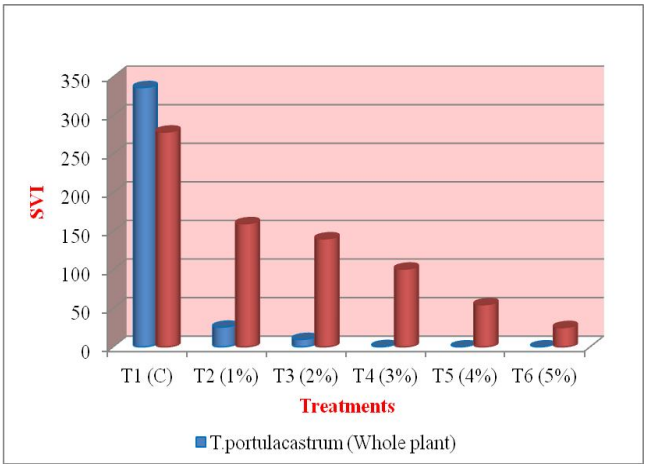


**Fig. 3:** Allelopathic effect of *T.portulacastrum* on SVI of green gram.

## Conclusion

From this experiment, it could be concluded that the whole plant as well as whole plant extract of *Trianthema portulacastrum* suppressed the germination and seedling growth of green gram.

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