Int. J. Biol. Res., 7(1): 57-65, 2019.

NEMATICIDAL ACTIVITY OF FRUIT PERICARPS AGAINST ROOT KNOT NEMATODE, *MELOIDOGYNE JAVANICA*

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ABSTRACT

The objective of this research is to evaluate the effects of different fruit pericarps against root-knot nematodes. Its effect on egg hatching and mortality of root knot nematode was observed. Aqueous extract of pericarps of Pomegranate (*Punica granatum*), Orange (*Citrus sinensis*), Amaltas (*Cassia fistula*), Castor (*Ricinus communis*), Chili (*Capsicum annuum*), Grapefruit (*Citrus vitis*) and Cheeku (*Manilkara zapota*) showed nematicidal potential against *Meloidogyne javanica* juveniles at various concentrations i.e.; 25, 50 and 100%. Maximum mortality of *M. javanica* larvae was shown by *Punica granatum, Capsicum annuum* and *Ricinus communis* in all tested concentrations. Similarly, decrease in egg hatching was observed by all fruit pericarps while maximum inhibition of egg hatching was shown by *Capsicum annuum*, *Citrus sinensis* and *Manilkara zapota* at all tested concentrations.

KEYWORDS: Fruit pericarps, Nematicidal activity, Root-knot nematode.

INTRODUCTION

Plant parasitic nematodes are responsible for crop losses every year worldwide of worth of 125 billion dollars (Chitwood, 2003). Most losses are mainly due to the root-knot nematodes, *Meloidogyne* species (Wesemael *et al.*, 2010). More than 2000 species of plants are found susceptible to infection by root-knot nematodes globally. Root-knot nematode produces poor growth, reduce quality and yield of the plants and make it more susceptible to other pathogens (Back *et al.*, 2002; Castello *et al.*, 2003; Manzanilla-Lopez and Bridge, 2004). Various strategies have been extensively used to manage phytonematodes in infested areas such as organic amendments, biological control and chemical nematicides. However, synthetic chemical; nematicides are possed environmental hazard, limited availability in many developing countries and due to high costs withdrawn from many countries (Dong and Zhang, 2006).

Organic amendments are generally used to improve crop productivity and increase soil fertility, has also shown suppressive effect on plant pathogenic fungi and nematodes (Alam *et al*., 1980; Tariq *et al.*, 2007; Abbasi *et al.*, 2008). A number of weedy plants are reported to contain Nematostatic and nematicidal potential – *A. mexicana* and *A. aspera* being the highly toxic against root-knot nematode, *Meloidogyne incognata* (Khan *et al.*, 2017), in form of inhibition of egg hatching and mortality of J2 juveniles, presumably due to the occurrence of alkaloids, flavonoids, tannins, saponins, phytosterols, mucilage gum in the aqueous extracts of these weeds. Numerous plant species, representing 57 families, have been shown to contain nematicidal compounds (Sukul, 1992).

A large number of plants however, not yet explored, which could be effective for the management of plant parasitic nematodes. Saha and associates isolated Triterpenic

saponins from fruit pericarp of *Sapindus mukorossi* and seeds of *Madhuca indica* exhibited nematicidal potential against *Rotylenchulus reniformis* and *Meloidogyne incognita* (Saha *et al.,* 2010; Goyal *et al.,* 2014). Little is known on nematicidal activity of fruit pericarps. Therefore present study is aimed to evaluate the effects of different fruit pericarps against root-knot nematodes.

MATERIALS AND METHODS

Collection of fruit pericarps: Fresh pericarps of different mature fruits were obtained from the market. Theses fruit pericarps were shade and pulverized. The powders of peels obtained of different fruits were stored separately in air tight bottles or jar. Aqueous extract of each of the peels of different fruits was prepared by soaking 10 g of the material in 100 mL of water for 24 h. After 24 h the extract was filtered with filter paper and used in different concentrations for egg hatching and larval mortality.

Effect of fruit pericarp extracts on nematodes egg hatch: To test the activity of fruit pericarp extracts on nematode egg hatching, root knots containing *Meloidogyne javanica* were obtained from heavily infested roots of eggplant (*Solanum melongena* L.). Roots were cut into small pieces and eggs were collected on 400-mesh sieve (Hussey and Barker, 1973). The eggs collected in distilled water in a beaker and were concentrated as of 40-60 eggs / mL of suspension. Then 2 mL of egg suspensions and 2 mL of freshly obtained aqueous extracts were transferred into a 2.5cm diameter glass cavity block, and kept at room temperature 28 ± 2°C. Each treatment was replicated three times. A second glass cavity block containing 2 mL of water, in addition to egg suspension served as control. After 24, 48 and 72 h, the number of hatched larvae were counted under low power stereoscopic microscope at a 60 X magnification.

Effect of fruit pericarp extracts on larval mortality: To study the effect of fruit pericarp extracts on the survival of nematode's larvae, nematode eggs or egg masses were incubated for 72 h at 28 ± 2°C for egg hatching. Subsequently, second stage juveniles per mL were counted using a counting chamber and 30 to 40 juveniles per mL were maintained. Then, 2 mL of larval suspension was transferred to a 2.5 cm diameter glass cavity block containing 2 mL of aqueous extracts. The experiment was conducted at room temperature. Each treatment was replicated three times. The glass cavity block containing 2 mL of water as well as 2 mL of larval suspension served as control. After 24, 48 and 72 h exposure, number of dead larvae were counted under a low power stereoscopic microscope at a 60 X magnification.

Analysis of data: Data were analyzed statistically and treatment means were compared by Duncan's multiple range test (DMRT) according to Gomez and Gomez (1984).

RESULTS

Effect of fruit pericarp extracts on nematodes egg hatch: Water extracts of Pomegranate (*Punica granatum*), Orange (*Citrus sinensis*), Amaltas (*Cassia fistula*), Castor (*Ricinus communis*), Chili (*Capsicum annuum*), Grapefruit (*Citrus vitis*) and Cheeku (*Manilkara zapota*) significantly ($p<0.05$) reduced egg hatching of nematodes at various concentrations i.e.; 25, 50 and 100%. Degree of inhibition observed, was directly

related to the concentrations of the extracts. Maximum inhibition against egg hatching was shown by *Capsicum annuum, Citrus sinensis* and *Manilkara zapota*, as indicated by strong activity in all concentrations (Fig. 1).

Effect of fruit pericarp extracts on larval mortality: Water extracts of pericarp of Pomegranate (*Punica granatum),* Orange (*Citrus sinensis*), Amaltas (*Cassia fistula*), Castor (*Ricinus communis*), Chili (*Capsicum annuum*), Grapefruit (*Citrus vitis*), Cheeku (*Manilkara zapota*) showed significant ($p<0.05$) nematicidal potential against *Meloidogyne javanica* juveniles at various concentrations i.e.; 25, 50 and 100%. Maximum mortality of *M. javanica* was shown by *Punica granatum, Capsicum annuum* and *Ricinus communis*, as indicated by strong activity in all concentrations (Fig. 2).

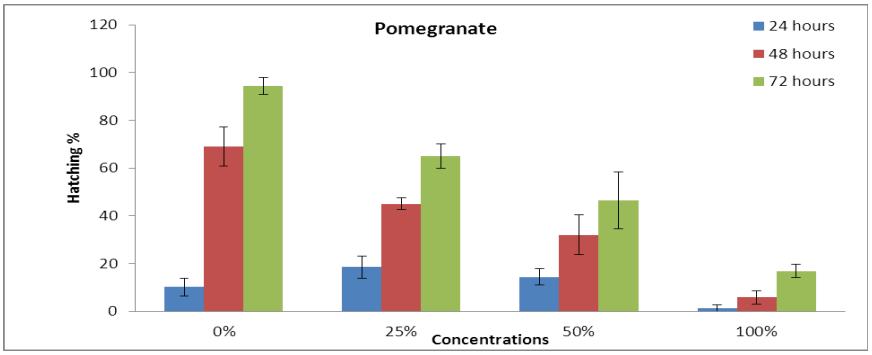
DISCUSSION

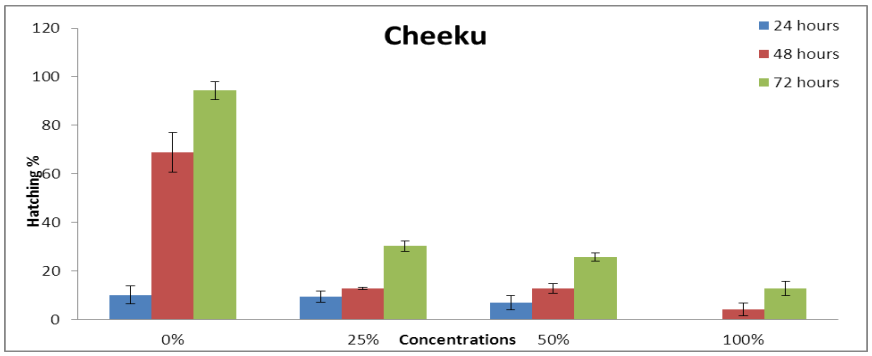
Parts of many plants and extracts have been considered as alternatives and effective control means of plant parasitic nematodes (Siddiqui and Alam, 1985). The use of botanicals in parasitic nematode control has received global attention. Extracts of many higher plants, like asteraceous and euphorbiaceous plants, have also shown nematicidal activity against many species of nematodes (Kawazu *et al*., 1980). Peel and pulp extracts of citrus fruits has antimicrobial and antioxidant activity and aqueous peel extract of orange possessed maximum antifungal activity against *Aspergillus niger* (Abhishek Mathur *et al.*, 2011 and Barrion *et al*., 2014).

In the present study *Punica granatum* and *Capsicum annuum* enhanced the mortality rate and inhibited egg hatching at all concentrations. Morthy *et al*. (2013) reported antimicrobial activity of *P. granatum* pericarp and results of ethanolic extract were also found significant against bacteria may be due to the presence of phenolic compounds, falvonoids, terpenoids, phytosterols and tenins. The extract of chili (*Capsicum frutescens*) was the best extract for the reduction of number of eggs and root galls with 2 products containing capsaicin, capsaicanoids and allylisothiocyanate (Neves *et al*., 2009).

Castor pericarp aqueous extract has shown nematicidal potential as it increased larval mortality and inhibited egg hatching and that its efficacy increases with concentration. Castor bean seed has shown lethal effect on aphids, (Bourne, 1999). Castor as organic amendment reduced the population of second-stage juveniles and eggs/egg mass and increased plant growth (Zaki and Bhatti 1990). Crude aqueous extract of castor seeds showed nematicidal activity (*In vitro*) at many different concentrations, that is lowers the hatching of eggs and increased the mortality (Adomako and Kwoseh, 2013; Siddiqui *et al.*, 2018).

Pericarp of *Cassia fistula* showed maximum potential against root-knot nematodes as it increased larval mortality as well as inhibited egg hatching. Toxic effects of cassia and cinnamon on *Bursaphelenchus xylophilus* and *M. javanica* was reported by Kong *et al.* (2007). Extract of *Manilkara zapota* pericarp inhibited egg hatching and increased larval mortality. Methanolic extract of *M. zapota* showed bactericidal activity (Kothari and Seshadri, 2010).


Pomegranate
24 hours
48 hours
72 hours
Hatching %
120
100
80
60
40
20
0
0%
25%
50%
100%
Concentrations


Cheeku
24 hours
48 hours
72 hours
Hatching %
120
100
80
60
40
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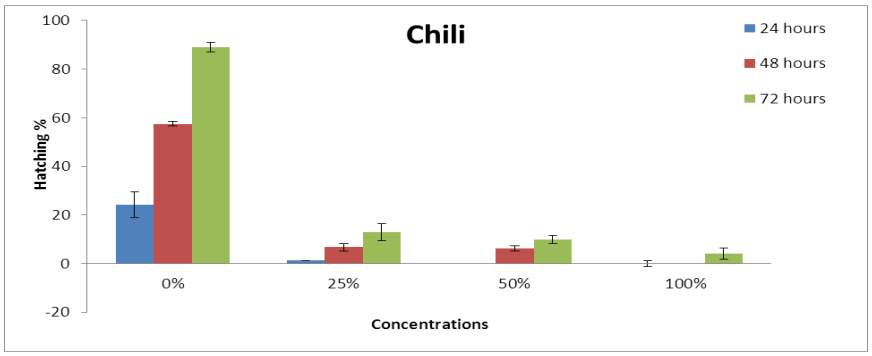
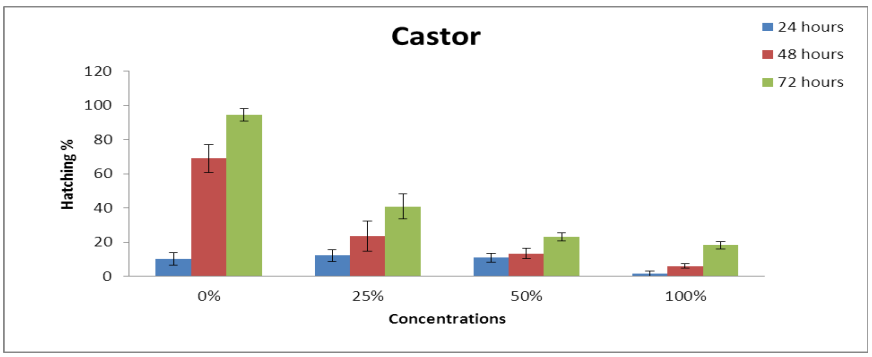
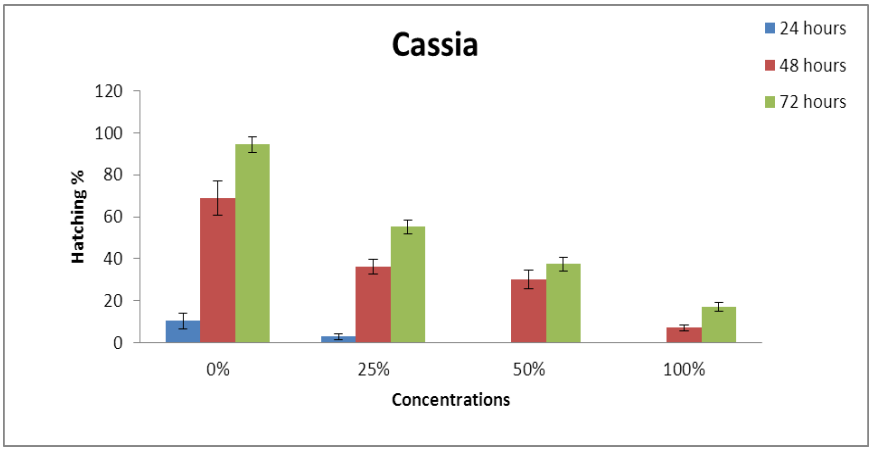
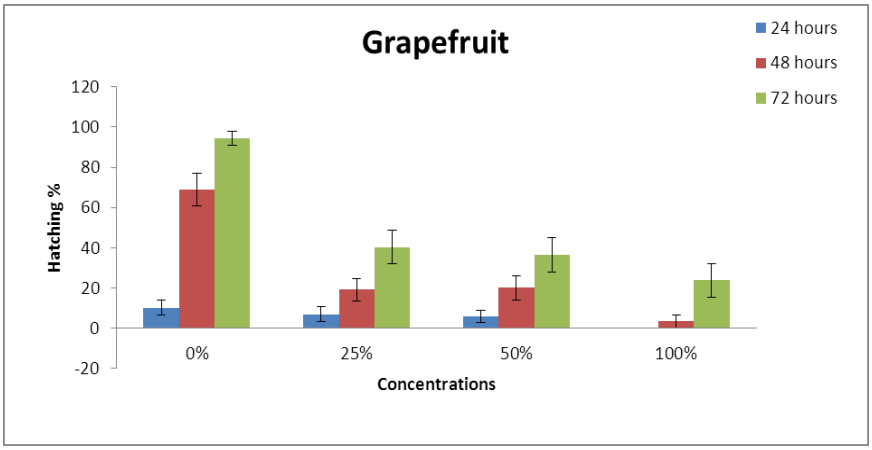
0
0%
25%
50%
100%
Concentrations


Chili
24 hours
48 hours
72 hours
Hatching %
100
80
60
40
20
0
-20
0%
25%
50%
100%
Concentrations


Castor
24 hours
48 hours
72 hours
Hatching %
120
100
80
60
40
20
0
0%
25%
50%
100%
Concentrations





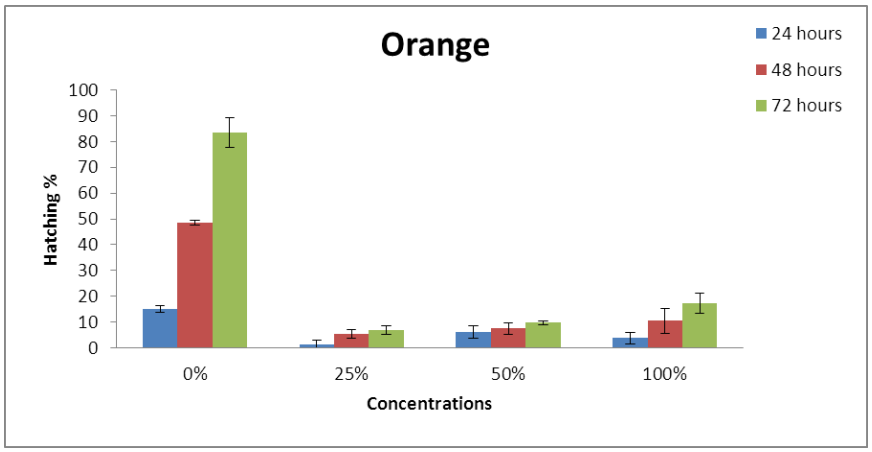
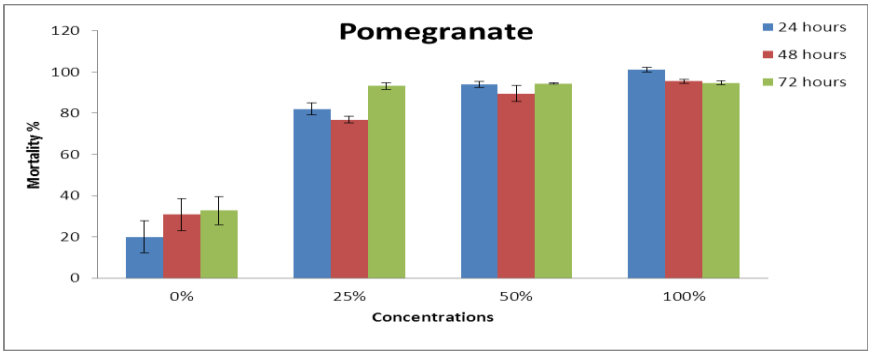
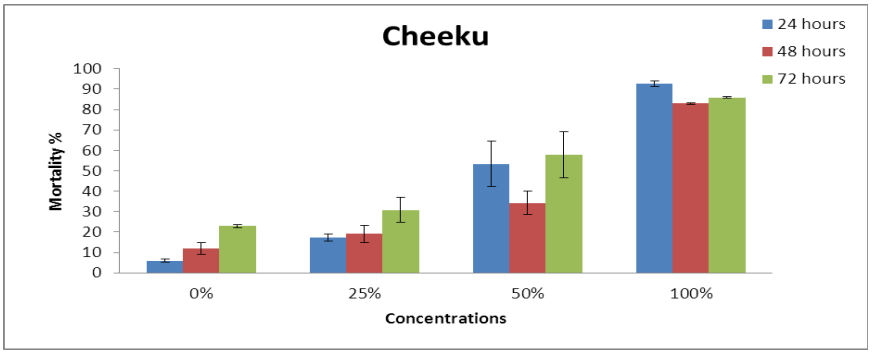
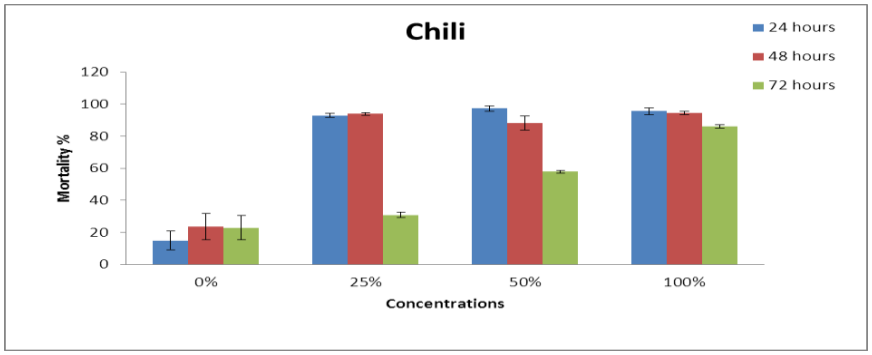
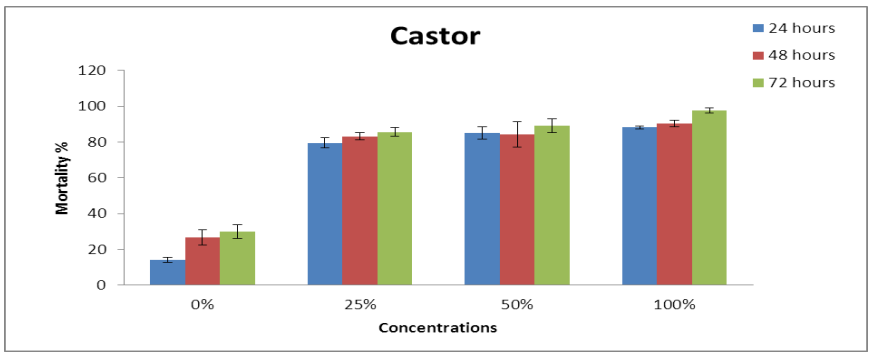


Fig. 1. Effect of fruit pericarp extracts on egg hatching of root-knot nematodes.
$LSD_{0.05}$: Concentration=2.58, Time=2.24, Treatments=3.42


Pomegranate
24 hours
48 hours
72 hours
Mortality %
120
100
80
60
40
20
0
0%
25%
50%
100%
Concentrations


Cheeku
24 hours
48 hours
72 hours
Mortality %
100
90
80
70
60
50
40
30
20
10
0
0%
25%
50%
100%
Concentrations


Chili
24 hours
48 hours
72 hours
Mortality %
120
100
80
60
40
20
0
0%
25%
50%
100%
Concentrations


Castor
24 hours
48 hours
72 hours
Mortality %
120
100
80
60
40
20
0
0%
25%
50%
100%
Concentrations

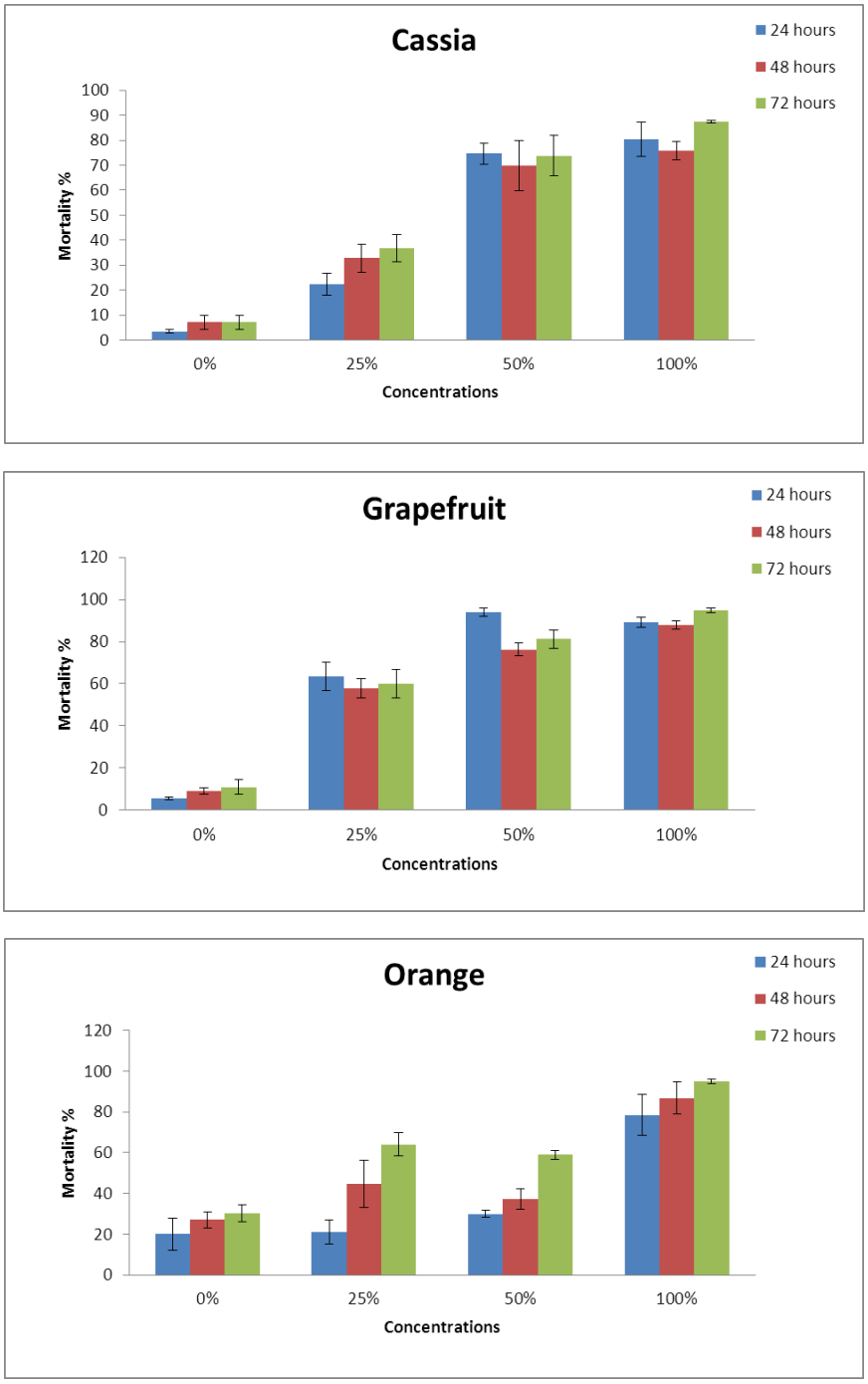


Fig. 2. Effect of Fruit pericarp extracts on mortality of root-knot nematodes.
$LSD_{0.05}$: Concentration = 2.87, Time = 2.49, Treatments = 3.80

CONCLUSIONS

It is concluded that aqueous extracts of different fruit pericarps like *Punica granatum, Capsicum annuum* and *Ricinus communis* showed nematicidal potential against *Meloidogyne javanica* juveniles at various concentrations i.e.; 25, 50 and 100%. Decrease in hatching was also observed by *Capsicum annuum*, *Citrus sinensis* and *Manilkara zapota* at all tested concentrations and would be explore as natural nematicides.

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(Received April 2019; Accepted June 2019)