



# FOLIAR SPRAY APPLICATION OF DIFFERENT PLANT BASED HOMEMADE INSECTICIDES AGAINST THE *PHENACOCCLUS SOLENOPSIS* TINSLEY (COTTON MEALYBUG) ON *HIBISCUS-ROSA SINENSIS*

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**Abstract:** Plants have some phytochemicals which have capacity to kill pests like mealybug, mites, flies etc. so homemade insecticides made up of plant material are beneficial to farmers and environment because they are cheaper in price and no any environment related threats are found. In present study, the work was carried out related removing mealybug population from 12 infected *Hibiscus rosa* plants by using different plant based homemade insecticides sprays like: Neem (*Azadirachta indica*), Aakdo (*Calotropis procera*), Lal Karen (*Nerium oleander*), Periwinkle (*Winca rosea*), Datura (*Datura stramonium*), Garlic (*Allium sativum*), Lemon (*Citrus Limon*), Orange (*Citrus sinensis*), Clove (*Syzygium aromaticum*) and Cinnamon (*Cinnamomum verum*). Different plant parts are used in the preparation of these insecticides like flower, leaf, seed, fruit and their parts. During this experiment highest percentage mortality was found in garlic, winca and nerium flower based insecticides treated plants, mostly 3<sup>rd</sup> instar and full growth female mealybugs were killed by using these. Medium percentage mortality (75%-60%) was found in lemon, clove, calotropis, neem and cinnamon based insecticides. Lowest percentage mortality was found in orange peel and nerium leaf based insecticides treated plants. These obtained results might be helpful in getting safe and good control against cotton mealybug.

**Key words:** *Phenacoccus solenopsis*, plant based insecticide, *Hibiscus-rosa sinensis*.

## I.INTRODUCTION

Mealybugs are 'hard to kill', soft wax covered body insect. It becomes major pest in short period of time and after infected plant. Insect sucks large amount of sap from leaves and stems with sucking mouthparts. *Phenacoccus solenopsis* (Cotton Mealybug) was first reported on weed roots in a nest of the ant, in U.S.A. (Williams and Ganara de Willink, 1992; Ben-Dov *et al.*, 2009). *Phenacoccus solenopsis* has a wide host range due to its biology and causes economic damage to several crops including ornamental, cotton, vegetable, medicinal plants, some fruit plants, crops and some weeds (Arif *et al.*, 2009). It spreads in Chile on *Solanum muricatum* (Ait)(Family: Solanaceae) (Larrain, 2002), in Argentina on *Ambrosia tenuifolia* Spreng (Family:Asteraceae) (Granara de Willink, 2003), in Brazil on (Tomato) *Solanum lycopersicum* L.

(Family: Solanaceae)(Culik and Gullan, 2005), in Caribbean and Ecuador on cotton (Ben-Dov, 1994), in Thailand and Taiwan on cotton and okra (Hodgson *et al.*, 2008),in Nigeria on china rose (Akintola and Ande, 2008), in India on cotton (Dharajothi *et al.*,2008;Jhala *et al.*,2008;Jhala and Bharpoda, 2008; Nagrare *et al.*, 2009; Monga *et al.*, 2009),in Pakistan on cotton (Abbas *et al.*, 2005; Zaka *et al.*, 2006; Muhammad, 2007; Arif *et al.*, 2009),in Sri Lanka on ornamental, vegetable crops and weeds, in Australia on cotton, in china on cotton (Wang *et al.*, 2009; Wu and Zhang, 2009; Wang *et al.*, 2010).

*Phenacoccus solenopsis* female looks relatively large, without wings, covered with mealywax, and six pair of black dots on dorsi-ventral body surface of mealybug and mostly exhibits parthenogenic mode of reproduction (Bhosle *et al.*, 2009). Female lays eggs in eggsac which coated with mealy waxand each eggsac holds 500 to 600eggs (Dhawan *et al.*, 2009). Eggs are small in size, 0.3 to 0.4mm in length. Male mealybugs are small in size as compare to female,smoky brown body and white transparent wings. Total life cycle of male takes 23 to 30days and female 55 to 61 days at 25 °C temperature. Male and female exhibits variations in growth stages. In female five growth stages and in male six growth stages are found (Franco *et al.*, 2009).

Mealybugs infections are mostly observed in plants belong to different families like, Malvaceae, Asteraceae,Fabaceae,Chenopodiaceae,Leguminosae,Solanaceae,Euphorbiaceae,Verbenaceae,Lamiaceae.In Malvaceae, Mealybug infection is most commonly found on *Hibiscus rosa sinensis* as ornamental plant.

## II. MATERIAL AND METHOD

### 2.1 Selected material:

Selected Host Plant- Mealybug infected hibiscus plants on fields

Location: Ahmedabad, Gujarat in two areas [Chandkheda and visat area]

Temperature: 25°C-31°C

Time duration: In two phases: 1-02-2021 to 15-02-2021 and 16-02-2021 to 02-03-2021.

### 2.2 Selected Plant Based Homemade Insecticides (Different categories and parts of plants):

- Poisonous plants:** Calotropis (leaves), Datura (seed).
- Medicinal plants:** Neem (leaves), Winca (leaves)
- Spices plants:** Clove (dried flower buds), Cinnamon (dried bark strip)
- Citrus plants:** Lemon (juice), Orange (peel extract)
- Ornamental plants:**Nerium (flower and leaves)
- Vegetable:** Garlic (cloves)

### 2.3 Parameters:

(On the basis of infection level)

- Low infection:** All stages of mealybug are found in low number.
- Medium infection:** All stages of mealybug are found in large number. Plant looks like dehydrated,plant parts are covered with mealybug showing white appearance.
- High infection:** All stages of mealybug are found in large number. Infected plant is dehydrated, excessive leaf and fruit shedding. Most of plants are died in the infected area.

**Table 1:** Details regarding selected plant based homemade insecticides

Plant scientific name	Common name	Family	Used part
<i>Azadirachta indica</i>	Neem	Meliaceae	Leaves
<i>Calotropis procera</i> (Wild.)	Aakdo	Asclepiadaceae	Leaves
<i>Nerium oleander</i>	Lal Karen,Nerium	Apocynaceae	Leaves
<i>Nerium oleander</i>	Lal Karen,Nerium	Apocynaceae	Flower
<i>Winca rosea</i>	Barmasi,Periwinkle	Rosaceae	Leaves
<i>Datura stramonium</i>	Datura,Jimson weed	Solanaceae	Seed
<i>Allium sativum</i>	Garlic	Amaryllidaceae	Garlic cloves
<i>Citrus limon</i>	Lemon	Rutaceae	Fruit juice
<i>Citrus sinensis</i>	Orange	Rutaceae	Fruit peels
<i>Syzygium aromaticum.</i>	Clove , long	Myrtaceae	Flower buds, driedcloves
<i>Cinnamomum verum</i>	Cinnamon	Lauraceae	Dried bark strips.

### III. PREPARATION OF EXTRACTS

**3.1 Leaf extract of neem, calotropis, nerium and winca:**-10-12 fresh leaves of neem, calotropis, nerium and winca were taken. Crush it with 10ml of tap water by using mortar and pestle. Whole mixture was strained using a clean muslin cloth and 70ml volume was obtained by further adding 60ml of water, shaken well and spray on the infected hibiscus plants at the evening. Make sure that the time interval for the foliar spray application was 24 hours.

**3.2 Flower extract of nerium:**-5-8 fresh flowers of *Nerium oleander* (red colour) were taken, crush it with 10ml of tap water, strained by using muslin cloth and 70ml volume was obtained by further adding 60ml of water, spray on the infected plant. Make sure that the time interval for the foliar spray application was 24 hours.

**3.3 Extract of garlic:**-5-8 garlic cloves were taken, grind it with the help of mortar and pestle. 70ml volume was obtained by adding 50ml of water, shake it well and the mixture was kept for three days, strained using a muslin cloth. Spray on infected plants. Make sure that the time interval for the foliar spray application was 3 days.

**3.4 Extract of orange peel:**-Taken out peels of one orange and 10ml of water is added. Mixture kept for 48 hours. Crush it and strained using a muslin cloth and 70ml volume was obtained by further adding 60ml of water. Shake it well and spray on infected plants. Make sure that the time interval for the foliar spray application was 48 hours.

**3.5 Extract of clove:**-10-15 cloves were taken. Add 50ml of water and leave it for overnight. Crush it with the help of grinder and shaken well. Mixture was kept for 48 hours in rest period. Strained by using muslin cloth and 70ml volume was obtained by further adding 20ml of water. Spray on infected plants. Make sure that the time interval for the foliar spray application was 2 days.

**3.6 Extract of lemon:**-1 medium size lemon, squeeze and taken a juice of it. 70 ml volume was obtained by further adding 50ml of water and spray on infected plants. Make sure that the time interval for the foliar spray application was 24 hours.

**3.7 Extract of datura seed:**-50 g of datura seed were taken. Crush it and added 70ml of water. Shake it well and mixture was kept for 48 hours in rest period. Strained using muslin cloth and Spray on infected plants. Make sure that the time interval for the foliar spray application was 2 days.

**3.8 Extract of cinnamon:**-15 g of cinnamon dried bark strips were taken and added 50ml of water over night and then crushed it and mixture was kept for 48hours, steam boiling and strained using muslin cloth and spray on infectious plant. Make sure that the time interval for the foliar spray application was 48hours. (Make sure the time duration should be perfect and particular in manner for all above solutions.)

**Table 2:** Table representing details regarding the foliar spray application (Selected host plants, infection level, foliar spray treatment, the time and the time duration of application)

Selected samples (on field)	Infection level	Foliar Spray Treatment	Treatment time duration
Plant 1	High infection	Neem (leaf ) Extract	Date:1/2/2021 to 15/2/2021 Spray Time:6 pm
Plant 2	High infection	Calotropis (leaf) Extract	Date:1/2/2021 to 15/2/2021 Spray Time: 6 pm
Plant 3	Low infection	Nerium (leaf) Extract	Date:1/2/2021 to 15/2/2021 Spray Time: 6 pm
Plant 4	Low infection	Nerium (flower) Extract	Date:1/2/2021 to 15/2/2021 Spray Time: 6 pm
Plant 5	Medium infection	Winca (leaf) Extract	Date:1/2/2021 to 15/2/2021 Spray Time: 6 pm
Plant 6	High infection	Datura (seed) Extract	Date:1/2/2021 to 15/2/2021 Spray Time: 6 pm
Plant 7	High infection	Garlic Extract	Date:16/2/2021 to 2/3/2021 Spray Time: 5 am
Plant 8	High infection	Lemon (juice) Extract	Date:16/2/2021 to 2/3/2021 Spray Time: 5 am
Plant 9	High infection	Orange (peel) Extract	Date:16/2/2021 to 2/3/2021 Spray Time: 5am
Plant 10	Medium infection	Clove Extract	Date:16/2/2021 to 2/3/2021 Spray Time: 6am
Plant 11	Medium infection	Cinnamon Extract	Date:16/2/2021 to 2/3/2021 Spray Time: 6 am
Plant 12	High infection	No treatment	Date:1/2/2021 to 2/3/2021 Spray Time: 7 am

**IV. FORMULA**

$$\text{Mortality\%} = \left[ \frac{\text{Population recorded before spray} - \text{Population recorded after spray}}{\text{Population recorded before spray}} \right] \times 100$$

$$\text{Percent correct Mortality\%} = \left[ \frac{\% \text{mortality in treatment} - \% \text{mortality in control}}{100 - \% \text{mortality in control}} \right] \times 100$$

## V. RESULT AND DISCUSSION

By using these two formulas of percentage mortality and correct percentage mortality was calculated as described by Schneider-Orelli's, 1947; Prishanthini and Vinobaba, 2014.

**Table 4.1:** Percentage mortality (Efficiency of different plant extracts against *Phenacoccus solenopsis* for the time duration of 0-14 days)

P- Extra ct	% Mortality with time intervals														
	day 0	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10	day 11	day 12	day 13	day 14
p-1- neem leaf spray	0.00	0.39	5.12	13.5 1	0.00	9.09	0.00	0.00	0.00	56.6 6	0.00	38.4 6	50	50	0.00
p-2- calotr opis leaf spray	0.00	2.22	3.03	0.00	16.4 1	2.80	0.00	0.00	23.0 8	18.7 5	0.00	66.1 5	9.09	25	26.6 7
p-3- neriu mleaf spray	0.00	10	5.55	11.7 6	13.3 3	7.69	0.00	0.00	8.33	27.2 7	50	25	33.3 3	0.00	0.00
p-4- neriu mflo wer spray	0.00	0.00	40	16.6 7	0.00	0.00	0.00	0.00	40	0.00	0.00	66.6 7	0.00	0.00	100
p-5- winca leaf spray	0.00	0.00	12.5	0.00	2.86	5.88	0.00	0.00	25	29.1 7	41.1 8	70	0.00	66.6 7	100
p-6- datura seed spray	0.00	0.00	7.41	3.20	13.2 2	6.67	0.00	16.3 3	37.8 0	0.00	0.00	11.7 6	33.3 3	0.00	10
p-7- garlic spray	0.00	15	24.0 3	7.14	12.0 9	3.75	9.09	4.29	23.8 8	5.88	27.0 8	14.2 9	50	66.6 7	100
p-8- lemon juice spray	0.00	22.5 8	15.8 3	12.8 7	20.4 5	5.71	37.8 7	26.8 3	0.00	0.00	50	33.3 3	20	0.00	75
p-9- orang e peel spray	0.00	0.00	3.20	1.65	6.72	9.91	6.00	4.26	2.22	3.41	5.88	2.50	0.00	6.41	0.00
p-10- clove spray	0.00	3.63	5.66	0.00	14	6.98	7.50	2.70	0.00	44	50.0 0	60.0 0	75	0.00	0.00
p-11- cinna mon spray	0.00	0.00	1.72	12.2 8	14	30.2 3	26.6 7	9.09	35	15.3 8	9.09	20	62.5 0	0.00	33.3 3

p-12 contr ol-no treat ment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.26	0.00	0.00	2.22
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In Table 4.1, Different plant extracts are showing their effects day by day and most effective results were seen between the time intervals of 7 to 14 days. Because the mealybug pest having waxy body cover and all the plant based homemade insecticides are applied as aqueous solutions. So, it becomes less effective and takes a little longer time to exhibit effect on plant infection.

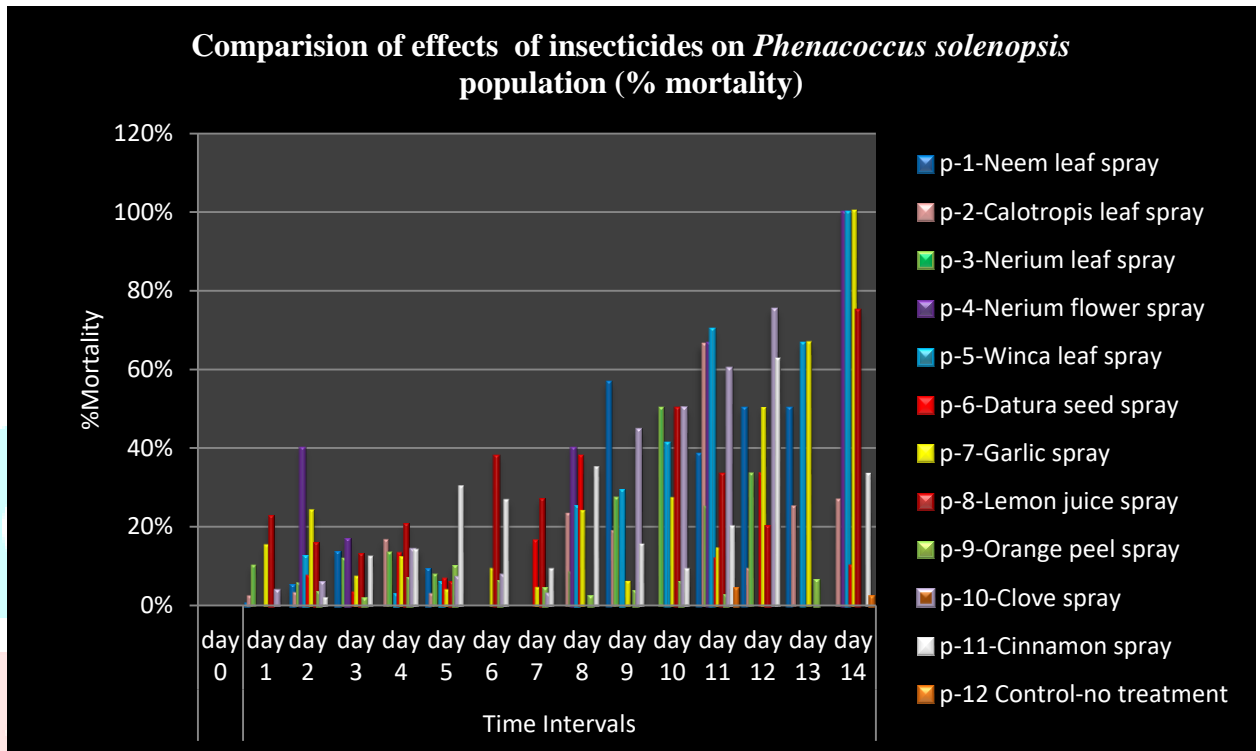


Figure 1–Comparison of effects of insecticides on *Phenacoccus solenopsis* population (% mortality)

This figure showed the comparison of % mortality of selected plant based homemade insecticides (plant extracts). The best results were obtained in garlic and lemon juice foliar spray application. Because this plant extracts contain concentrated acid which are more effective than other aqueous solutions.



Figure 2 Selected plants before treatment (day 0)

(Note: These all selected plants 1 to 12 are treated with foliar spray for 14 days, Table 2).

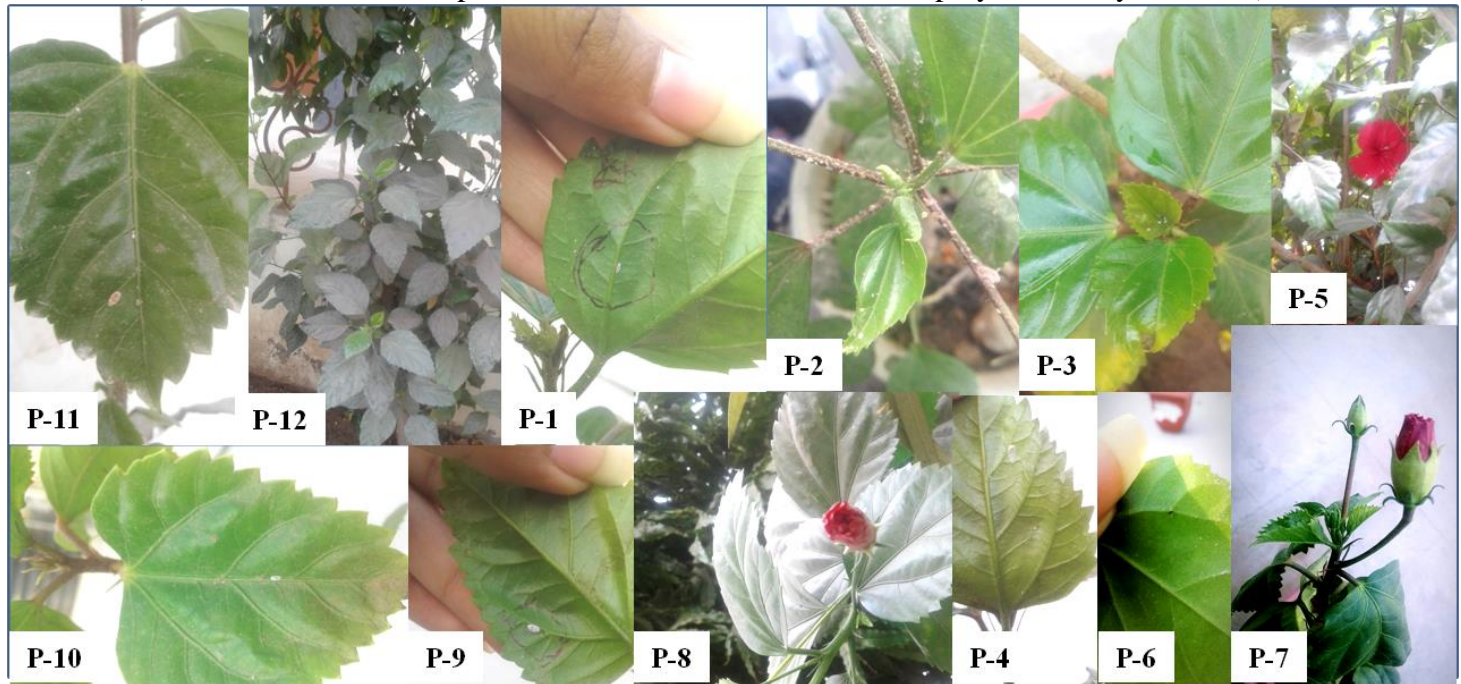


Figure 3- Selected plants after treatment (day 14)

Table 4.2 - Correct percentage mortality of selected plant extracts.

P-Extract	Correct % mortality with time interval														
	day 0	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10	day 11	day 12	day 13	day 14
p-1- neem leaf spray	0.00	0.39	5.12	13.51	0.00	9.09	0.00	0.00	0.00	56.66	0.00	35.72	50	50	2.27
p-2- calotropis leaf spray	0.00	2.22	3.03	0.00	16.41	2.80	0.00	0.00	23.08	18.75	0.00	64.64	9.09	25	25.00
p-3- nerium leaf spray	0.00	10	5.55	11.76	13.33	7.69	0.00	0.00	8.33	27.27	50	21.66	33.33	0.00	2.27
p-4- nerium flower spray	0.00	0.00	40	16.67	0.00	0.00	0.00	0.00	40	0.00	0.00	65.19	0.00	0.00	100
p-5- winca leaf spray	0.00	0.00	12.50	0.00	2.86	5.88	0.00	0.00	25	29.17	41.18	68.67	0.00	66.67	100
p-6- datura seed spray	0.00	0.00	7.41	3.20	13.22	6.67	0.00	16.33	37.80	0.00	0.00	7.83	33.33	0.00	8.00
p-7- garlic spray	0.00	15	24.03	7.14	12.09	3.75	9.09	4.29	23.88	5.88	27.08	10.48	50	66.67	100
p-8- lemon juice spray	0.00	22.58	15.83	12.87	20.45	5.71	37.87	26.83	0.00	0.00	50	30.36	20	0.00	74.43

p-9- orange peel spray	0.00	0.00	3.20	1.65	6.72	9.91	6.00	4.26	2.22	3.41	5.88	-1.83	0.00	6.41	0.00
p-10- clove spray	0.00	3.63	5.66	0.00	14	6.98	7.50	2.70	0.00	44	50	58.22	75	0.00	0.00
p-11- cinnamo n spray	0.00	0.00	1.72	12.28	14	30.23	26.67	9.09	35	15.38	9.09	16.44	62.50	0.00	31.82
p-12- control- no treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The correct percentage mortality was calculated by using the given formula without any errors. Mortality rate was found to be increased with increasing concentration of applied extracts. But in some of extracts, increasing concentration had been exhibited side effects against the plant growth. Calotropis based extract treated plants were showed more leaf falling as compare to other plants and no new leaf or flower buds were seen raised on the treated plant.

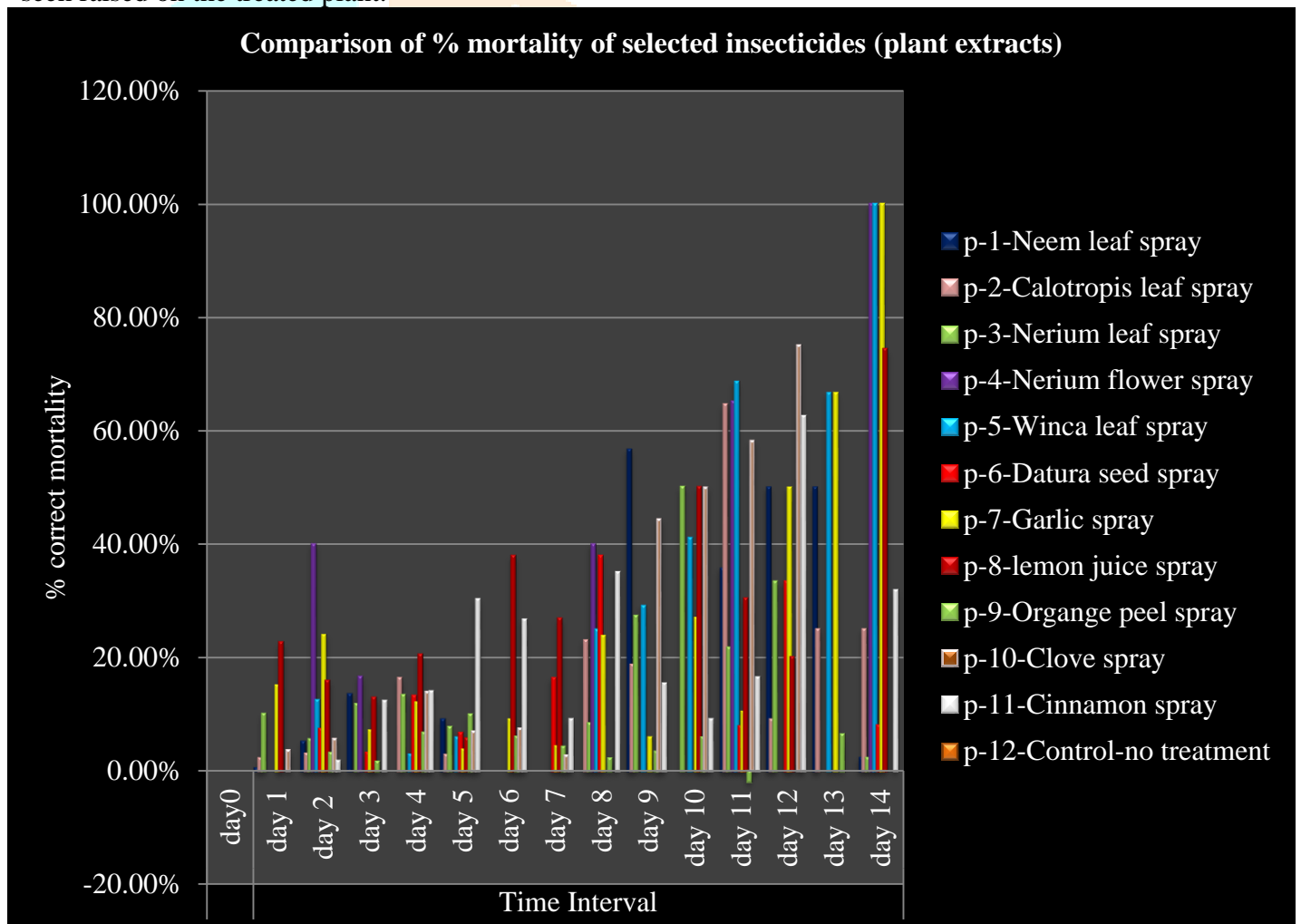


Figure 4-Comparison of % mortality of selected insecticides (plant extract)

This figure exhibited the comparison of correct percentage mortality of all selected plant based homemade insecticides (plant extracts). 100% results were seen in garlic, winca and nerium flower extract treatments. Lowest results were seen in the orange extract treatment. There were only 2 mealybugs found which were naturally dead after laying egg into eggsac in control plant. The naturally death mealybug was covered with white fluffy cotton fungal like structure in control plant which was not observed in other treated plants. In



nerium flower extract treated plant leaves were started become yellowing and no any new leaf buds were found arising. So the plant which is poisonous in nature, its extract also showed poisonous effects on plant growth and mostly symptoms seen were included leaf fall and leaf yellowing, no any new buds and leaf buds were found arising. Citrus fruit and essential oil both were given good results by decreasing mealybug populations. Citrus fruits were not found to give any side effects to plant but essential oil was found to damage leaf surface and make it rough. Neem extract treatment exhibited good results on mortality of mealybug and no any harmful effects on plants were found. Control plant was found looked like dehydrated and leaves were seen not healthy, no new buds were raised as compare to other treated plants.

## VI. CONCLUSION

In conclusion, extracts having nerium flower, winca leaf, garlic exhibited 100% mortality, lemon juice 74.43% after 14 days, clove showed 75% mortality after 12 days, calotropis showed 64.64% mortality after 11 days, neem aqueous solution showed 56.66% mortality after 9 days. The lowest mortality were seen in extracts having nerium leaf 50%, orange 9.91% and datura seed 37.80%. In control plant, no mortality was found in this period of 14 days.

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