



## Research Article

# Evaluation of non-chemical methods in the management of garlic mite complex

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## Abstract

Mites are noxious pests infesting the garlic crop leading to significant yield loss. Several synthetic chemicals have been used over several decades; however, the extensive use of the chemicals has deleterious effects on both human health and the environment. Hence, a field experiment was conducted at the College of Horticulture, Bidar to evaluate the different non-chemical traditional methods against the garlic mite complex during 2020-21. Among the different treatments, sequential water spray -NSKE 5% at an interval of 24 hrs registered the lowest mean carmine spider mite population after the first spray (16.57/sq. cm of leaf) and second spray (15.82/ sq. cm of leaf). Further, it also recorded the highest mite population reduction over control to an extent of 64.90% and 65.98%, after the first and second spray, respectively. The sequential water spray -Pongamia seed extract 3% was next best with 61.99 and 63.01 percent reduction over control after the first and second spray, respectively. Similar results were obtained during 2021-22. The sequential water spray - NSKE 5% also proved to be best against bulb mites as it recorded the lowest lacerations on the garlic cloves (25.36 and 27.15%) with the highest reduction in laceration (51.57 and 51.21%) and the highest yield (27.00q/ha and 25.80q/ha) during 2020-21 and 2021-22, respectively.

**Keywords** garlic, mites, NSKE 5%, pongamia, teepol

## Introduction

Garlic (*Allium sativum* L.) is an important spice crop grown all over the world for its aroma, and high nutritional and medicinal value. It also contains compounds that have anti-cancerous and anti-inflammatory properties [1]. The therapeutic value of the crop is mainly due to the presence of sulfur-containing compounds, saponins, and phenolic compounds [2-4]. The crop is grown in an area of 4.29 lakh hectares with production of 34.98 lakh tonnes during 2021-22.

The crop ravaged by several insect and non-insect pests viz., onion maggot, *Delia antiqua* (Meigen), onion thrips, *Thrips tabaci* Lindeman, carmine spider mite, *Tetranychus cinnabarinus* Biosudal, bulb mite, *Rhizoglyphus robini* Claparede and eriophyid mite, *Aceria tulipae* (Keifer). Among the different pests, mites and thrips are more serious pests, which cause the leaf curling and deterioration of the bulb quality leading to significant yield loss [5]. Mite infestation generally increases with increasing atmospheric temperature. Bulb mites infest later in the

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season during the bulb formation stage by way of laceration on the cloves. They cause qualitative and quantitative yield losses. Several pesticides have been tried to curb the mites. However, the extensive use of chemical pesticides causes several ill effects on both human health and the ecosystem [6]. Hence the present investigation was designed to combat the mite pests with indigenous approaches that are ecofriendly and more sustainable.

## Methodology

The experiment was conducted at the College of Horticulture, Bidar during Rabi 2020-21 and 2021-22 in Randomized Block Design (RBD), having nine treatments that were replicated thrice with a plot size of 3m X 1m. The garlic cloves of the Rajalli cultivar were soaked in 2% mineral oil for 2-3 hours before planting in all the treatments except untreated control and were planted at a spacing of 15cm x 7.5cm (plant to plant x row to row). The crop was raised by following recommended package practices for the region except for sprays against mite pests. Nine treatments (as detailed in Table 1) were imposed once the pest reached the ETL second spray was taken up after 15 days of the first spray. The sprays were taken up as high-volume sprays @500litres of spray fluid per hectare.

**Table 1. Details of the treatments**

S.N.	Treatments
1	Water spray - 2% mineral oil spray (Sequential spray at an interval of 24 hrs)
2	Water spray & mid-season irrigation to counter the extreme aridity
3	Water spray - Teepol @ 1 ml/litre of water (Sequential spray at an interval of 24 hrs)
4	Water spray - Cotton seed oil 2% (Sequential spray at an interval of 24 hrs)
5	Water spray- <i>Pongamia</i> seed extract 3% (Sequential spray at an interval of 24 hrs)
6	Water spray - NSKE 5% (Sequential spray at an interval of 24 hrs)
7	Water spray - Garlic extract 5% (Sequential spray at an interval of 24 hrs)
8	Water spray - Clove oil 1.5%
9	Untreated Control

### ***Neem seed kernel extract (NSKE) 5% preparation***

Fresh neem seeds collected were finely ground and 25 kg of seed powder was put in a cloth bag and then soaked in 100 litres of water overnight. The next day morning the bag filled with neem seed powder was squeezed to get the aqueous content into the water. The aqueous extract then was filtered through the muslin cloth to remove the debris and then the volume was made up to 500 litres to get NSKE 5%.

### ***Pongamia seed extract 3% preparation***

Dried seeds of *Pongamia glabra* were ground to prepare powder and then passed through the 40-mesh sieve. Fifteen kilograms of sieved seed powder was soaked in 100 litres of water overnight, shaken thoroughly, and filtered through the muslin cloth and then the volume was made up to 500 litres to prepare 3% aqueous seed extract of *Pongamia glabra* as prescribed by Puttarudriah M and Bhatta [7], and Deshmukh and Borle [8].

### ***Garlic extract 5% preparation***

The garlic cloves were separated from the fresh garlic bulb and 25 kg of cloves were crushed and thoroughly mixed with 100 litres of water. The preparation was then filtered through the muslin cloth and the volume was made up to 500 litres to prepare 5% of garlic extract.



### Observations

#### *Carmine spider mite, Tetranychus cinnabarinus*

Observation on Carmine spider mite was taken a day before, 1, 3, 7, and 14 days after spray. Five plants were randomly selected from each plant, and the number of adult and younger stages mites were counted under the microscope in 1 sq. cm of leaf area.

#### *Bulb mite, Rhizoglyphus robini*

Before the harvest, five plants were randomly picked from each plot, and the observations on the number of cloves with laceration due to bulb mite and the total number of cloves and expressed percent laceration on cloves.

The percent reduction of carmine spider mite and bulb mite over control was calculated as follows.

$$\text{Percent reduction over Control} = \frac{\text{Observations in UTC} - \text{Observations in Treatment}}{\text{Observations in UTC}} \times 100$$

### Yield

At harvest, fruit yield recorded per plot was extrapolated to yield per hectare and expressed as quintals per hectare. The percent increase over control was computed as follows.

$$\text{Yield increase over Control (\%)} = \frac{\text{Yield in Treatment} - \text{Yield in Control}}{\text{Yield in Control}} \times 100$$

The observations on the number of carmine spider mites and yield were ( $\sqrt{0.5+x}$ ) transformed and the observations on percent reduction over control and percent increase over control were arc sine transformed. The data was subjected to a single-factor Analysis of Variance (ANOVA).

## Results and Discussion

#### *Carmine spider mite, Tetranychus cinnabarinus*

A day before the first spray, the carmine spider mite population in all the treatments was uniform and non-significant, during 2020-21. The observations recorded one Day After Treatment (1DAT) showed significant differences among the treatments and all the treatments were superior to the untreated control (Table 2). The treatment with NSKE 5% in sequential spray recorded significantly the lowest mites (21.27/sq. cm of leaf). The present findings corroborate with reports of Fadel and Ascher [9] who reported the mortality, decreased fecundity, and repellency in *Tetranychus cinnabarinus* in the treatments with the extracts of neem. The Pongamia seed extract 3% was the second best treatment with 23.92 mites/sq. cm of leaf. The present findings can be supported by reports of Kanchana et al. [10] who recommended oil extracted from Pongamia glabra as an effective remedy against the *T. cinnabarinus* on jasmine. The cottonseed oil 2%, Teepol 1ml/litre, garlic extract 3%, mid-season irrigation, clove oil 1.5%, and mineral oil 2% did not show good acaricidal properties as they recorded higher mite population (27.57, 28.98, 30.27, 31.49, 33.18 and 34.75 mites/sq.cm of leaf, respectively) (Table 2). Similar observations were made by Madanlar et al. [11] and Mansour et al. [12] who reported very poor acaricidal activity of Teepol and garlic extract, respectively on the various stages of the *Tetranychus cinnabarinus*. The untreated control registered the highest mite population (41.25/sq.cm of leaf). A similar trend was observed at 3DAT, 7DAT, and 14 DAT. The NSKE 5% treated plot recorded the highest mite population reduction over control (64.90%) followed by, Pongamia seed extract 3% (61.99%). The lowest mite reduction over control was observed in 2% mineral oil (33.75%). The observation made during the second spray showed a



**Table 2. Effect of different management practices on carmine spider mites in garlic -2020-21.**

S.N.	Treatments	No. of Mites/sq.cm of leaf (First Spray)						Reduction Over Control (%)
		1DBT	1DAT	3DAT	7DAT	14DAT	Mean	
1	Water spray - 2% mineral oil spray (Sequential spray at an interval of 24 hrs)	33.81 (5.86)	34.75 (5.93)	33.5 (5.83)	29.7 (5.49)	27.25 (5.26)	31.30	33.75
2	Water spray & mid-season irrigation to counter the extreme aridity	34.44 (5.91)	31.49 (5.65)	28.94 (5.42)	25.73 (5.12)	22.58 (4.80)	27.18	42.46
3	Water spray - Teepol @ 1 ml/litre of water (Sequential spray at an interval of 24 hrs)	33.2 (5.81)	28.98 (5.42)	27.54 (5.29)	22.33 (4.77)	19.38 (4.45)	24.55	48.03
4	Water spray - Cotton seed oil 2% (Sequential spray at an interval of 24 hrs)	32.79 (5.77)	27.57 (5.29)	25.84 (5.13)	23.98 (4.94)	20.45 (4.57)	24.46	48.22
5	Water spray- Pongamia seed extract 3% (Sequential spray at an interval of 24 hrs)	34.14 (5.89)	23.92 (4.94)	19.55 (4.47)	15.08 (3.94)	13.26 (3.70)	17.95	61.99
6	Water spray - NSKE 5% (Sequential spray at an interval of 24 hrs)	32.89 (5.78)	21.27 (4.66)	19.45 (4.46)	13.05 (3.68)	12.54 (3.61)	16.57	64.90
7	Water spray - Garlic extract 5% (Sequential spray at an interval of 24 hrs)	33.01 (5.79)	30.27 (5.54)	25.76 (5.12)	24.54 (5.10)	21.11 (4.64)	25.42	46.19
8	Water spray - Clove oil 1.5%	34.29 (5.89)	33.18 (5.80)	31.25 (5.63)	30.71 (5.58)	29.08 (5.43)	31.05	34.28
9	Untreated Control	33.38 (5.82)	41.25 (6.46)	45.55 (6.78)	49.5 (7.07)	52.75 (7.29)	47.26	-
SEm±		0.15	0.06	0.04	0.07	0.03		
CD (P=0.05)		NS	0.22	0.18	0.24	0.11		

Figures in the parentheses represent ( $\sqrt{0.5+x}$ ) transformed values, NS-Non significant  
DBT- Day before Treatment, DAT- Days after Treatment  
ROC- Reduction over untreated Control

similar trend wherein NSKE 5% treatment recorded the highest mite reduction over control (65.98%), followed by Pongamia seed extract 3% (63.01%). The lowest reduction of mite population was registered in mineral oil 2% (34.31%) (Table 3). The observations made during 2021-22 showed a similar trend as in 2020-21 where in lowest mean mite population was registered in the plot treated with NSKE 5% (19.51/sq. cm of leaf) with the highest reduction over control (60.26%) after first spray (Table 4). The Pongamia seed extract 3% was next best with 20.19 mites/sq.cm of leaf and 58.88 percent reduction over control. The untreated control recorded the highest mean mite population (49.11/sq. cm of leaf). A similar trend was noticed during the second spray of 2021-22 (Table 5). Azadirachtin has broad-spectrum activity, it acts as a feeding deterrent, insect growth disruptor (IGD), and sterilant and at the cellular level affects protein synthesis and secretion [13]. Due to its multiple modes of action, it has been very effective in controlling the mite population. Hence, it could reduce the mite population to the highest. Similarly, Karanjin from the *Pongamia glabra* which was responsible for the antifeedant activity and growth



**Table 3. Effect of different management practices on Carmine Spider mite in garlic -2020-21**

S.N.	Treatments	No. of Mites/sq.cm of leaf (Second Spray)						Reduction Over Control (%)
		1DBT	1DAT	3DAT	7DAT	14DAT	Mean	
1	Water spray - 2% mineral oil spray (Sequential spray at an interval of 24 hrs)	34.61 (5.92)	34.00 (5.87)	32.75 (5.76)	28.95 (5.42)	26.50 (5.19)	30.55	34.31
2	Water spray & mid-season irrigation to counter the extreme aridity	35.24 (5.97)	30.74 (5.58)	28.19 (5.35)	24.98 (5.04)	21.83 (4.72)	26.43	43.17
3	Water spray - Teepol @ 1 ml/litre of water (Sequential spray at an interval of 24 hrs)	34.00 (5.87)	28.23 (5.36)	26.79 (5.22)	21.58 (4.69)	18.63 (4.37)	23.80	48.82
4	Water spray – Cotton seed oil 2% (Sequential spray at an interval of 24 hrs)	33.59 (5.83)	26.82 (5.22)	25.09 (5.05)	23.23 (4.87)	19.70 (4.49)	23.71	49.02
5	Water spray- Pongamia seed extract 3% (Sequential spray at an interval of 24 hrs)	34.94 (5.95)	23.17 (4.86)	18.80 (4.39)	14.33 (3.85)	12.51 (3.60)	17.20	63.01
6	Water spray - NSKE 5% (Sequential spray at an interval of 24 hrs)	33.69 (5.84)	20.52 (4.58)	18.70 (4.38)	12.30 (3.57)	11.79 (3.50)	15.82	65.98
7	Water spray - Garlic extract 5% (Sequential spray at an interval of 24 hrs)	33.81 (5.85)	26.81 (5.22)	25.01 (5.05)	23.79 (4.92)	20.36 (4.56)	23.99	48.41
8	Water spray – Clove oil 1.5%	35.10 (5.96)	32.43 (5.73)	30.50 (5.56)	29.96 (5.51)	28.33 (5.36)	30.30	34.85
9	Untreated Control	33.38 (5.82)	40.50 (6.40)	44.80 (6.73)	48.75 (7.01)	52.00 (7.24)	46.51	-
SEm±		0.13	0.05	0.05	0.06	0.03		
CD (P=0.05)		NS	0.17	0.17	0.22	0.12		

Figures in the parentheses represent ( $\sqrt{0.5+x}$ ) transformed values, NS-Non significant

DBT- Day before Treatment, DAT- Days after Treatment

ROC- Reduction over untreated Control

reduction in *Spodoptera litura* as reported by Vishal et al. [14] was also found very effective in controlling *T. cinnabarinus* in the present study.

### **Bulb mite**

The observations made on the damage caused by the bulb mite during 2020-21 revealed a significant difference among the treatments. The NSKE 5% treated plot recorded the lowest laceration on the cloves (25.36%) with the highest reduction over the control (51.57%) (Table 6). This is mainly due to multiple modes of action by azadirachtin viz., growth inhibition, feeding deterrence, and infertility and interference in the protein synthesis and secretion as reported by Samira et al. [13]. The Pongamia seed extract 3% was next best with 34.41 percent lacerations on the cloves and 34.37 percent reduction over control, which was mainly due to antifeedant and growth inhibitory activity of Karanjin present in the Pongamia as reported by Vishal et al. [14] in *S. litura*. The untreated control recorded the highest lacerations (52.50%). Again, during 2021-22, the NSKE 5% was best with the lowest laceration on cloves (27.15%) with the highest reduction over control (51.21%) and Pongamia registered 37.16 percent lacerations on the cloves with 33.23 percent reduction over the control.



**Table 4. Effect of different management practices on carmine spider mite in garlic -2021-22**

S.N.	Treatments	No. of Mites/sq.cm of leaf (First Spray)					Mean	Reduction Over Control (%)
		1DBT	1DAT	3DAT	7DAT	14DAT		
1	Water spray - 2% mineral oil spray (Sequential spray at an interval of 24 hrs)	35.39 (6.77)	31.55 (5.66)	29.85 (5.50)	25.50 (5.09)	21.75 (5.31)	27.16	44.69
2	Water spray & mid-season irrigation to counter the extreme aridity	36.02 (6.82)	28.94 (5.42)	26.39 (5.18)	24.22 (4.97)	20.05 (4.53)	24.9	49.29
3	Water spray - Teepol @ 1 ml/litre of water (Sequential spray at an interval of 24 hrs)	34.37 (6.7)	25.02 (5.05)	22.29 (4.77)	21.47 (4.68)	20.47 (4.57)	22.31	54.56
4	Water spray - Cotton seed oil 2% (Sequential spray at an interval of 24 hrs)	34.78 (5.93)	24.43 (4.99)	23.99 (4.94)	23.82 (4.93)	21.85 (4.72)	23.52	52.10
5	Water spray- Pongamia seed extract 3% (Sequential spray at an interval of 24 hrs)	35.72 (6.01)	22.37 (4.78)	21.06 (4.64)	19.57 (4.47)	18.73 (4.38)	20.19	58.88
6	Water spray - NSKE 5% (Sequential spray at an interval of 24 hrs)	34.47 (5.91)	21.98 (7.74)	20.53 (4.58)	19.54 (4.47)	16.01 (4.06)	19.51	60.26
7	Water spray - Garlic extract 5% (Sequential spray at an interval of 24 hrs)	34.59 (5.92)	31.01 (5.61)	28.21 (5.35)	27.03 (5.24)	25.58 (5.10)	27.95	43.08
8	Water spray - Clove oil 1.5%	35.87 (6.03)	34.63 (5.92)	30.70 (5.58)	29.2 (5.44)	28.55 (5.38)	30.77	37.34
9	Untreated Control	34.55 (5.92)	45.75 (6.80)	46.80 (6.87)	49.40 (7.06)	54.50 (7.41)	49.11	-
SEm±		0.14	0.08	0.05	0.03	0.06		
CD (P=0.05)		NS	0.24	0.17	0.11	0.20		

Figures in the parentheses represent ( $\sqrt{0.5+x}$ ) transformed values, NS-Non significant  
 DBT- Day before Treatment, DAT- Days after Treatment  
 ROC- Reduction over untreated Control

The untreated control recorded the highest lacerations (55.65%) (Table 6).

**Yield**

At harvest, the NSKE 5% recorded the highest yield 27.00 and 25.80 q/ha which was an 83.05 and 91.11 percent increase over the control, during 2020-21 and 2021-22, respectively. The Pongamia seed extract 3% was next best with 26.16 and 24.84 q/ha yield. The untreated control registered the lowest yield among the different treatments (14.75 and 13.50 q/ha during 2020-21 and 2021-22, respectively.) Such a variation in the yield among the different treatments was mainly due to the difference in the damage caused by carmine spider mite and bulb mite among the different treatments.





**Table 5. Effect of different management practices on carmine spider mite in garlic -2021-22**

S.N.	Treatments	No. of Mites/sq.cm of leaf (Second Spray)						Reduction Over Control (%)
		1DBT	1DAT	3DAT	7DAT	14DAT	Mean	
1	Water spray - 2% mineral oil spray (Sequential spray at an interval of 24 hrs)	34.85 (5.94)	32.75 (5.76)	31.60 (5.66)	30.55 (5.57)	29.95 (5.51)	31.21	28.75
2	Water spray & mid-season irrigation to counter the extreme aridity	31.15 (5.62)	30.24 (5.54)	29.84 (5.50)	28.67 (5.40)	27.82 (5.32)	29.14	33.47
3	Water spray - Teepol @ 1 ml/litre of water (Sequential spray at an interval of 24 hrs)	35.57 (6.00)	33.32 (5.81)	28.74 (5.40)	27.57 (5.29)	25.72 (26.22)	28.08	35.88
4	Water spray - Cotton seed oil 2% (Sequential spray at an interval of 24 hrs)	31.95 (5.69)	30.73 (5.58)	28.44 (5.37)	27.27 (5.26)	25.42 (5.09)	27.96	36.16
5	Water spray- Pongamia seed extract 3% (Sequential spray at an interval of 24 hrs)	33.33 (5.81)	30.61 (5.57)	27.61 (5.30)	27.44 (5.28)	19.59 (4.48)	26.31	39.92
6	Water spray - NSKE 5% (Sequential spray at an interval of 24 hrs)	31.95 (5.69)	29.02 (5.43)	26.01 (5.14)	23.84 (4.93)	15.99 (4.06)	23.71	45.85
7	Water spray - Garlic extract 5% (Sequential spray at an interval of 24 hrs)	34.70 (5.93)	33.31 (5.81)	31.15 (5.62)	30.98 (5.61)	30.13 (5.53)	31.39	28.34
8	Water spray - Clove oil 1.5% (Sequential spray at an interval of 24 hrs)	34.60 (5.92)	33.93 (5.86)	32.66 (5.75)	31.49 (5.65)	30.64 (5.58)	32.18	26.53
9	Untreated Control	35.70 (6.01)	37.50 (6.16)	41.50 (6.48)	46.55 (6.85)	49.75 (7.08)	43.82	-
SEM±		0.18	0.04	0.03	0.05	0.03		
CD (P=0.05)		NS	0.15	0.14	0.17	0.13		

Figures in the parentheses represent ( $\sqrt{0.5+x}$ ) transformed values, NS-Non significant  
 DBT- Day before Treatment, DAT- Days after Treatment  
 ROC- Reduction over untreated Control



**Table 6. Effect of different management practices on bulb mite and yield in garlic**

S.N.	Treatments	2020-21		2021-22		2020-21		2021-22	
		Lacerations on cloves (%)	ROC (%)	Lacerations on cloves (%)	ROC (%)	Yield (q/ha)	Percent increase over control	Yield (q/ha)	Percent increase over control
1	Water spray - 2% mineral oil spray (Sequential spray at an interval of 24 hrs)	40.75 (39.67)	22.33	42.47 (40.67)	23.68	22.8	54.58	21.52	59.41
2	Water spray & mid-season irrigation to counter the extreme aridity	42.79 (40.85)	18.45	43.52 (41.28)	21.80	23.3	57.97	21.80	61.48
3	Water spray - Teepol @ 1 ml/litre of water (Sequential spray at an interval of 24 hrs)	37.89 (37.99)	27.75	40.60 (39.58)	27.04	24.20	64.07	22.84	69.19
4	Water spray - Cotton seed oil 2% (Sequential spray at an interval of 24 hrs)	44.47 (41.83)	15.26	45.22 (42.26)	18.74	19.84	34.51	18.60	37.78
5	Water spray- Pongamia seed extract 3% (Sequential spray at an interval of 24 hrs)	34.41 (35.92)	34.37	37.16 (37.56)	33.23	26.16	77.36	24.84	84.00
6	Water spray - NSKE 5% (Sequential spray at an interval of 24 hrs)	25.36 (30.24)	51.57	27.15 (31.40)	51.21	27.00	83.05	25.80	91.11
7	Water spray - Garlic extract 5% (Sequential spray at an interval of 24 hrs)	46.08 (42.75)	12.20	45.70 (42.53)	17.88	18.12	22.85	16.92	25.33
8	Water spray - Clove oil 1.5% (Sequential spray at an interval of 24 hrs)	47.79 (43.73)	8.95	48.48 (44.13)	12.88	17.8	20.68	16.56	22.67
9	Untreated Control	52.50 (46.43)		55.65 (48.24)		14.75		13.50	
SEm±		1.41		1.23		0.09		0.06	
CD (P=0.05)		4.35		3.96		0.32		0.21	

Figures in the parentheses represent ( $\sqrt{0.5+x}$ ) transformed values, NS-Non significant  
 DBT- Day before Treatment, DAT- Days after Treatment  
 ROC- Reduction over untreated Control





## Conclusion

The lowest carmine spider mite population and lacerations caused by the bulb mite in NSKE 5% treatment can be attributed to the multitude in the modes of action by the azadirachtin present in the aqueous extract of neem, which was evidenced by the highest yield recorded by NSKE 5%.

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