~~Assessing the~~ Efficacy of ~~Oil-Based Formulations~~sesame oil and mustard oil formulationsagainst for ~~Controlling~~ Red Spider Mite of tea.~~in Tea Plantations~~

ABSTRACT

~~Home-made~~Crude formulations of sesameandmustardoil~~basedformulations~~at 0.5%, 0.75% and 1% concentration with or without the addition of cow ~~were~~urine were~~takenfor~~assessed~~laboratoryexperimentationon~~against redspidermite,*Oligonychu scoffeae*(Nietner)in the laboratory.~~at0.5%,0.75%and1%concentrationaloneandincombinationwithcowurinetos tudyitsefficacyon ovipositionrate, egg hatchability,mortalityofnymphandadultmites.~~Efficacy tests on oviposition rate, egg hatchability, mortality of nymph and adult mites proved that ~~Allthetreatmentsofsesameoil and~~ sesameoil1%, ~~sesame oil1%+~~with or without the addition ofcowurine~~5%were~~was found to be effectiveinreducing the rateoviposition and egghatchabilityof mites ~~respectively whichwere~~andwas atparwiththeformulation prepared fromcommercialneem(1:1500).Formulations of ~~Sesame~~sesame oilat the rate of 0.75%~~+cowurine5%,sesameoil1%, sesameoil1%+cowurine5% and sesame oil 0.75%, sesame oil 0.75% + cow urine 5%, sesame oil 1%, sesame oil~~and 1% ~~+~~ with or without cow urine ~~5%~~werefoundtobehighly effectiveformortalityofnymphs and adultsofredspidermiterespectivelywhichwereatparwiththeformulation prepared fromcommercialneem.

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~~**Keywords**~~**Key** ~~:~~**words**:~~Commercial neem~~Commercial ~~,~~ ~~cow~~neem, ~~urine~~cow ~~,~~ ~~mustard~~urine, ~~oil~~mustard ~~,~~ ~~Red~~oil, Red spider ~~mite,sesame~~mite,~~oil~~sesame oil, Tea

1. INTRODUCTION

Tea~~[~~(*Camelliasinensis*(L).O.Kuntze)~~]~~isanexport-oriented,perennial,plantationcropgrowninmorethan50countriesaroundtheworld.Them ajorteaproducingcountriesincludeChina,India,KenyaandSriLanka.Theteagrowingarea s~~ofIndiaarecategorizedintotworegionsnamelyNorthIndiaandSouthIndia.~~NorthEastIndi a~~fallsundertheNorthIndiaregionwhich~~liesbetween24^0 and27^0 Northlatitudesand88^0 a nd95^0 Eastlongitudesandatanelevationrangingfrom20minplainsanduptoaheightof200 0minDarjeeling.Theredspidermite,*Oligonychuscoffeae*(Nietner)~~,belongstothefamilyTe tranychidaeoftheorderAcarina.It~~isapolyphagouspest~~whichisfoundinawidedistribution~~w idely distributed~~inalmostallteagrowingregions.~~Red~~Both nymphs and adults of ~~spider~~red ~~mite~~spider ~~normally~~mite~~attack~~normally attacks~~s~~the~~uppersurface~~upper ~~of~~surface ~~the~~of thematureleavesbut~~,~~inseverecases~~it~~spreadstotheyoungleavesandalsototheundersurf aceofleaves.~~Thedamageismainlycausedbythenymphsandadultstagesofthemitewhichf eedonthesapoftheleaves.Theattackstartsalongthemid-ribandveins,onthedepressionsofleavesandgraduallyspreadstothewholesurface.Theda mageischaracterisedbyreddishbrownmarkswhichdevelopatthefeedingpointsandasare sultofrepeatedsucking,brownpatchesareformedontheuppersurfacewhichturnsultimate lybronze.Thebushes~~The ~~are~~bushes

arebadlyheavilydefoliatedinsevereinfestationaffectingtheyieldofthecrop.leading toThisresultsincroplossfrom17to46%(Roy*etal*.,2014).

Redspidermitebreedsthroughouttheyearandcanbefoundatanytimeontheteabushes.Thepopulationstartsincreasingfromearly March and reaches their peak during early April. Injury becomes most severe during May and continues till the monsoon rains wash off the active forms. A slight attack may develop in September or October. During the cold weather, the multiplication rate decreases and the mites present on the bushes is in small number. But this small population is also responsible for the damage caused in the next season. Many factors such as drought, planting materials, type of pruning, road side bushes, defoliation, shade trees, type of manuring, drainage, cultivation practices, weather conditions are involved in the occurrence of red spider mite. Many acaricides being are used worldwide play a major role in the management of *Oligonychus O. coffeae*. But frequent application of these acaricides have serious drawbacks such as toxicity to non-target organisms, pesticide induced resistance because of frequent application, other than health hazard s and presence of higher levels of residues in made tea (Sharaby, 1988). Pesticide residues has caused As a result of dissatisfaction of among consumers and importers regarding pesticide residues the problem and has become a major concern to the tea industry. In order to minimize such crisis in the tea industry and to protect crops in modern agriculture, it is a need of the hour to limit the use of synthetic acaricides and to promote alternative practices that are based on non-chemical methods which are less toxic to man, easily adoptable, cost effective and easily available. Thus with the above frame of reference, the use of use plant of based plant based oils may re presenta novel class of crop protectants which are readily available in the market and their preparation is easy and less time consuming. viable option. The advantage The advantage of plant based oils is that it contains complex mixtures of monoterpenes, phenols, sesquiterpenes which not only repel insects and mites but also have contact and fumigant activity (Koul *et al*.,2008). Several studies pointed out the neurotoxic action of essential oils by acetylcholinesterase (AchE) inhibition or by blocking the octopamine receptors. The essential oils varied in their activity which may be due to variation of their chemical constituents (Enan, 2001). There are also several reports on cow urine having pesticidal properties which are presently being used by many tea growers of Assam. Cowurine Cow urine spraying on the infested bushes can minimize the harmful effects of synthetic pesticides and it was reported that stored stock is preferred over fresh urine because it can cause leaf scorching and plant wilting (Gahukar, 2013). Keeping the above facts in mind the In the present investigation cow urine spraying was tested was undertaken which may serve as an attractive alternative to synthetic chemical insecticides.

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2. MATERIALS AND METHODS

2.1 Collection and preparation Preparation of oil based formulations experimental materials

Comment [GN5]: What was the ratio of cow urine and oil in the final formulation. For example, how much quanity of 0.5% of oil was added to 5% cow urine?

Home made Crude preparations mustard of mustard oil and sesame and oil sesame were oil were taken for used experimentation for experimentation on experimentation on red spider mite, *Oligonychus . coffeae*. The aqueous The aqueous solution aqueous of solution 0.5 of 0.5%, 0.75 %, 0.75% and % 1 and 1% of % both of these both these oils were made and 2-3 drops of teepol was

added to it, (Teepol - AG, National Organic Chemical Industries Limited, Mumbai, India) which acts as an emulsifier.

~~**Cow urine**~~

~~Cow urine~~Cow ~~was~~urine ~~collected~~was ~~from~~collected ~~the~~from ~~dairy~~the ~~farm~~dairy ~~of~~farm ~~Assam~~of ~~Agricultural~~Assam ~~University~~Agricultural University, Jorhat during November - December, 2020. ~~A 5% solution of cow urine~~Cow urine~~was diluted as 5% solution~~made ~~and was added~~was ~~to~~added ~~the~~to the oils,which served as the ~~treatment.~~

~~**Tea clone**~~

~~Mature leaves~~treatment. Mature ~~leaves of~~leaves ~~clone~~of ~~TV~~clone TV~~21 maintained~~21 ~~at~~maintained ~~the~~at ~~Experimental~~the ExperimentalGarden for Plantation Crops (EGPC), Assam Agricultural University, Jorhatwas utilizedfor mass rearing of mites and experimentation.M

~~**Mass culture of test insect**~~

~~Maintenence of~~aintenance of~~*Oligonychus O.coffeae* culture~~*coffeae*culture was done ~~based on~~using the detached leaf technique proposed by Das *et al*. (2012) in the laboratory during 2019 - 2021and used for the studies.

2.2Forumulations

The experiment was laid in completely randomized designed with 14 treatments replicated six times. The treatments were: T1 - Mustard oil (0.5%),T2 - Mustard oil (0.5%) + cow urine (5%),T3 - Mustard oil (0.75%),T4 - Mustard oil (0.75%) + cow urine (5%),T5 - Mustard oil (1%),T6 - Mustard oil (1%) + cow urine (5%),T7 - Sesame oil (0.5%),T8 - Sesame oil (0.5%) + cow urine (5%),T9 - Sesame oil (0.75%),T10 - Sesame oil (0.75%) + cow urine (5%),T11 - Sesame oil (1%),T12 - Sesame oil (1%) + cow urine (5%),T13 - Commercial neem (1 : 1500),andT14 - Water (Control).

2.~~2~~ 3 ~~Application of treatment~~Evaluation against egg, nymphs and adults of~~on~~ *Oligonychuscoffeae*

~~From the stock culture of *O. coffeae* reared on detached leaves, ten numbers of o~~One-~~day old~~day old*O.coffeae* adults were allowed to settle for 24 hours ~~on a TV 21 clone leaf disc~~ at the rate of 10 numbers per ~~of~~ 2.5 cm^2 leaf disc (TV 21 clone). ~~and~~ Respective ~~sprayed with~~ oil formulationwas applied either with ~~and~~ orwithout cow urine at different desired concentrations ~~by~~ using ahand atomizer (Make: Axiva, Capacity: 50ml). Each treatment was replicated six times and ~~data on~~ adult mortality were ~~recorded~~ observed at 24, 48 and 72 hours after treatment (HAT) ~~visually with the help of~~through a stereoscopic microscope~~ic~~. A control treatment of water spray was maintained.~~to compare biocefficacy against *O. coffeae*. Moreover, commercial~~Moreover, commercial neem formulation (1 : 1500) dilution) was also applied to compare the bioefficacy. Same method was followed for evaluation against the nymph~~al stage of red spider mite.~~s.

To evaluate the ovicidal property of different oil formulations along with cow urine or without cow urine, ten ~~spider mite~~ gravid females were allowed

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" Leaf discs treated with the formulations were allowed for oviposition by-- number of adult mites and the eggs were counted after --hrs to study the oviposition rate".

Comment [GN9]: What was the commercial formulation used?

to lay eggs on leaf disc for 24 hours. Thirty freshly laideggs wereeounted retainedfor each replication and the other eggs were discarded offremoved from the leaves along with the adult mites. Then tThe newly laid eggs were sprayed with different concentrations of tested oil based formulations as above . Each treatment was replicated six times. Theand the first observation was recorded as soon as the eggs in the control hatched. Those eggs which did not hatch during this period were regarded as non - viabledead.

The experiments were conducteduring October - November, 2020 and repeated during March - April, 2021.

2.3 Experimental details

1. Total number of treatments : 14

2. Total number of replications : 6

3. Design of the experiment : Completely Randomized Design

The details of the treatments are given as below:

T1 - Mustard oil (0.5%)

T2 - Mustard oil (0.5%) + cow urine (5%)

T3 - Mustard oil (0.75%)

T4 - Mustard oil (0.75%) + cow urine (5%)

T5 - Mustard oil (1%)

T6 - Mustard oil (1%) + cow urine (5%)

T7 - Sesame oil (0.5%)

T8 - Sesame oil (0.5%) + cow urine (5%)

T9 - Sesame oil (0.75%)

T10 - Sesame oil (0.75%) + cow urine (5%)

T11 - Sesame oil (1%)

T12 - Sesame oil (1%) + cow urine (5%)

T13 - Commercial neem (1 : 1500)

T14 - Water (Control)

2.4 Observations and sStatistical analysis

The treatment observations mean values that were recorded on parameters includedof the rate of oviposition, percent reduction in egg hatchability, nymph and adult mortality at different time interval. s wereAnalysis of variance was carried out as per the design following standard statistical procedure.The treatment mean values was compared by least significance difference based on ANOVA (Gomez and Gomez, 1984). All computations was carried out by using MS Excel 2007 and OPSTAT software.

3. RESULTS AND DISCUSSION

3.1 Rate of oviposition

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The data on oviposition rate of *O. coffeae* are presented in Table 1. During the period October - November, 2020all the formulations based on sesame oil T7-T12(2.20-9.33%) was werefound to be equally effective among themselves as well as T13(neem oil) but significantly better than mustard oil formulations (T1-T6) in reducing the ovipositon rate of *O.coffeae*(Table 1) among the oil based formulations followed by T11 (3.88%) and T10 (4.72%). During Similar trend was observed in the tests conducted duringthe period March - April, also.Both2021 T12 (6.11%) was found to be effective among the oil based formulations followed by T11 (6.61%) and T10 (7.71%). Among the two selected oil based formulations, sesame oil showed more efficacy on rate of oviposition than mustard oil in both the periods. Mustard oil and sesame oil when sprayed with and without cow urine showed effective resultsthe oil formulations were significantly different than control (water) induring both the periodstests. For both the periods, all the treatments of sesame oil were at par with theformulation prepared from commercial neem (1:1500). Oils have been proven to be effective oviposition deterrant in earlier studies. The results of the experiment were almost in conformity with the findings of Roy *et al*., (2015).They observed that clove oil (an essential oil from the clove plant, *Syzygium aromaticum*) inhibit oviposition of tea red spider mite. TTheherate of deposition of eggsoviposition rate of by mites on treated leaf surfaces as well as the egg viability rate of eggs decreased significantlyon clove oil (*Syzygiumaromaticum*)- treated leaf surfaces with the application of the oil(Roy *et al*., 2015) . Likewise, Dam *et al*., (2021) evaluated Betweenacaricidal properties of *Simarouba glaucaSimaroubaglauca* and*Hydnocarpuspentandra* seed oils ,*H. pentandra* wasmore effective in reducing oviposition rate ofagainst*O. coffeae*(Dam et *al*., 2021) .under laboratory conditions. The oviposition deterrence study revealed that the least number of eggs were laid on the treatments of *H. pentandra*seed oil which can confirm the present study.

Table 1. Effect of oil based formulations on rate of oviposition of red spider mite during both the periods

Treatments	Rate of oviposition (%)	
	72 Hours after treatment	
	October - November, 2020	March - April, 2021
T_1	23.88	27.22
T_2	20.00	24.50
T_3	18.50	23.00
T_4	16.00	20.66
T_5	16.11	19.33
T_6	15.33	18.67
T_7	9.33	12.33
T_8	6.11	9.22

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T_9	7.11	9.77
T_{10}	4.72	7.71
T_{11}	3.88	6.61
T_{12}	2.20	6.11
T_{13}	2.19	6.10
T_{14}	50.66	65.22
S.Ed	7.99	7.67
CD $p = 0.05$	12.98	12.33

3.2 Reduction in egg hatchability

The data on percent reduction in egg hatchability of red spider mite during both the periods are presented in Table 2. During the period October - November, 2020,T13 (63.77) , T12 (62.22%) and was found to be most effective among the oil based formulations followed by T11 (55.55%) and T10 (51.66%).were equally effective with the highestpercent reduction in egg hatchability(Table 2). Among them T13 and T12 were significantly better than all other treatments while T11 had overlapping levels of significance with several other treatments.During the period March - April, 2021 T12 (58.88%) was found to be most effective among the oil based formulations followed by T11 (52.21%) and T10 (49.33%).Similar trend was observed in the tests conducted in March-April 2021.Among theAmong twothe selectedtwo oilselected oil based formulations, sesame oil showed more efficacy on percent reduction in egg hatchability than mustard oil in both the periods. Mustard oil and sesame oil when sprayed with and without cow urine showed effective results than control (water) in both the periods.

For bothDuring theboth periodsthe , Ttests, T11 andT12 were at par with theformulation prepared fromcommercial neem.Plant based oils, in general, possess excellent ovicidal properties and are effective even at few parts per million (Benelli, 2015). The oils affected the eggs hatchability without any morphological changes by disrupting or inhibiting embryogenesis and making them unable to come out of the egg shells (Ibrahim, 2019). High ovicidalactivity of *Jatropha curcus* and *Allium sativum* even at low concentrations have been proven by(1 : 1500). The findings are in agreement with the findings of Roy, (2018). They found that the oils of *Jatropha curcus* and *Allium sativum* showed outstanding ovicidal activity even at low concentrations. The finding is also comparable with the work of Roy *et al.*, (2018). They observed that aAmongll the plant oils of derived fromcastor, sesame, rose, olive, mustard, groundnut and karanja, the egg hatchability was significantly reduced the egg hatchabilityaffected in all treatmentsbut with rose oil being was most toxic of themovicide among the plant oilsfollowed by karanja oil and olive oil(Roy *et al.*, (2018). They observed that . Plant based oils, in

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~~general, posses excellent ovicidal properties and found to be effective even at few parts per million (Benelli, 2015). The oils affected the eggs hatchability without any morphological changes by disrupting or inhibiting embryogenesis and making them unable to come out of the egg shells (Ibrahim, 2019). Five plant oil based formulations prepared by considering individual as well as combination of~~ Single and combined formulations of~~Sesamum~~ *S.indicum* and*Millettiapinnata* seed oil at different ratios showed significant ovicidal activity against eggs of *O. coffeae*~~ also showed significant ovicidal activity~~ (Sarmah*et al*., 2020)~~.which is in line with the present study.~~

Table 2. Effect of oil based formulations on percent reduction in egg hatchability of red spider mite during both the periods

Treatments	Percent reduction in egg hatchability (%) 72 Hours after treatment	
	October - November, 2020	March - April, 2021
T_1	39.44	34.44
T_2	40.77	38.32
T_3	44.44	41.10
T_4	49.99	46.66
T_5	48.88	46.11
T_6	49.99	46.66
T_7	44.44	42.55
T_8	46.66	42.77
T_9	47.77	44.44
T_{10}	51.66	49.33
T_{11}	55.55	52.21
T_{12}	62.22	58.88
T_{13}	63.77	60.33
T_{14}	23.33	20.22
S.Ed	4.97	5.06
CD p= 0.05	9.95	10.11

3.3 Nymph mortality

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The ~~mean data on percent mortality of nymphs after 24, 48 and 72 hours of treatment during both the periods are presented in Table 3. In case of nymphs,~~ highest nymphalmortality of was observed on T12 among the oil based formulations in both the periods(Table 3). ~~. Significant reduction~~The mortality rates ~~was~~ recorded in T12 ~~upto~~were 90.67%, 94.33% and 98.00% ~~in~~ at24, 48 and 72 hours after application respectively during the period October-November, 2020 and 88.00%, 95.00% and 96.67% in 24, 48 and 72 hours after application during the period March-April, 2021 respectively, However, observations at 72 hours after treatment in both the periods indicated that T10, T11 and T12 were ~~at~~ onpar with T13 (theformulation prepared fromcommercial neem ~~(1:1500~~) ~~. after 72 hours of treatment in both the periods.~~

Table 3. Effect of oil based formulations on nymph mortality of red spider mite during both the periods

Treatments	Nymph mortality (%)					
	October - November, 2020			March - April, 2021		
	24 HAT	48 HAT	72 HAT	24 HAT	48 HAT	72 HAT
T_1	46.67	65.00	73.00	38.33	61.67	70.33
T_2	50.33	70.00	78.32	43.33	63.33	73.67
T_3	51.67	75.00	82.33	46.67	65.00	74.33
T_4	61.33	80.00	85.00	65.00	70.33	75.67
T_5	63.33	76.67	83.00	63.80	72.67	76.33
T_6	78.33	80.67	87.00	70.33	73.00	77.00
T_7	80.00	81.33	88.33	73.67	79.00	82.33
T_8	81.33	83.67	90.00	75.33	81.67	85.22
T_9	79.97	86.33	90.67	76.90	86.33	86.67
T_{10}	83.00	91.33	94.33	81.67	88.67	93.00
T_{11}	85.33	93.00	95.67	84.33	92.33	96.33
T_{12}	90.67	94.33	98.00	88.00	95.00	96.67
T_{13}	91.33	98.67	99.33	88.67	95.33	98.67
T_{14}	7.33	8.33	8.67	6.33	7.67	8.33
S.Ed	5.85	4.45	3.82	6.52	5.01	4.35
CD p=0.05	11.70	8.90	7.64	13.05	10.01	8.68

HAT : Hours after treatment

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3.4 Adult mortality

The mean data on percent mortality of adults after 24, 48 and 72hours of treatment during both the periods are presented in Table 4. In case of adults, highest Highest adultmortality wasmortality observedwas onobserved Ton T12 among12 theamong oilthe basedoil formulationsbased informulations bothin theboth periodsthe periods. Significant reduction was recorded uptoThe mortality rates 89.67were 89.67%, 93.33%, 93.33% and 97.00% in at24, 48 and 72 hours respectively after application respectively during the period October - November, 2020 and 88.33%, 93.00% and 96.67% in 24, 48 and 72 hours after application respectively during the period March - April, 2021. However, THowever, T9, T9, T10, T10, T11 and T12 were at par withtheformulation prepared fromcommercial neem (1 : 1500) after 24, 48 and 72 hours after treatment in both the periods, at all the time periods tested. The toxic effect of oils is due to their fumigant (Ayvaz *et al.*, 2009) and/or contact toxicities (Kim *et al*., 2003) of the major components of these oils or by inhibition of acetylcholinesterase activities. Some authors also reported that monoterpenoids presentMonoterpenoids inpresent oilsin causeoils insectcause mortalityinsect bymortality inhibitingby acetylcholinesteraseinhibiting enzymeacetylcholinesterase enzyme activity (Sertkaya*et al*., 2010) possibly by activation of octopaminergic receptors (Kostyukovsky, 2002). Among seven plant based oils such as castor oil, sesame oil, rose oil, olive oil, mustard oil, groundnut oil andKaranja oil tested against *O. coffeae*,The present findings can be compared with the findings of Roy *et al*., (2018). They found karanja oil to be the most toxic adulticide.evaluated the anti-mite properties of seven plant based oils viz., castor oil, sesame oil, rose oil, olive oil, mustard oil, groundnut oil and karanja oil against *O. coffeae* and found that among the plant oils, karanja oil was the most toxic adulticide followed by mustard oil and olive oil. Likewise, Sarmah *et al*., (2020) evaluated the efficacy of five plant oil based formulations prepared by considering individual as well as combination of *S. indicum* and *M. pinnata* seed oil against adults' stages of *O. coffeae*. Two seasonIn two seasons fieldof field trials,bio-efficacy results indicated that the formulationstheformulations basedon S.*indicum* and *M. pinnata*seed oilare were found to behighly effectivehighly againsteffective *O.*against O.*coffeae* and*coffeae* andwere superior tosuperior commonlyto usedcommonly chemicalused acaricidechemical, Ethionacaricide, 50Ethion 50EC(Sarmah *et*Sarmah al.et *al.*, (, (2020).which can be comparable with the present study. Also another work evaluated that the Significant adult mortality in *O. coffeae*had been achieved acaricidal properties ofdue toapplication of seed oils from *Simarouba S.glauca*and *HydnocarpusH.pentandra*achieved significant mortality over adult red spider mite which can be related with the present study (Dam *et al*., 2021).

Thus, the present study demonstrated the efficacy of different oil based formulations separately or in combination with cow urine for the management of red spider mite in tea.

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~~Table 4~~Table 4. Effect of oil based formulations on adult mortality of red spider mite during both the periods

Treatments	Adult mortality (%)					
	October - November, 2020			March - April, 2021		
	24 HAT	48 HAT	72 HAT	24 HAT	48 HAT	72 HAT
T_1	38.33	65.67	73.33	33.33	51.67	60.00
T_2	46.63	67.63	75.67	38.33	55.00	58.33
T_3	46.67	69.33	79.33	40.00	60.00	70.00
T_4	68.33	75.00	82.33	60.00	72.33	78.33
T_5	76.67	83.00	83.66	65.00	75.33	79.33
T_6	78.00	83.33	84.00	70.00	77.67	84.00
T_7	80.67	84.67	85.33	72.00	81.00	85.33
T_8	81.00	85.00	87.33	75.00	82.33	86.67
T_9	82.00	85.27	93.67	76.22	86.67	89.33
T_{10}	82.33	90.33	94.00	81.67	90.00	91.33
T_{11}	83.33	92.67	94.67	83.33	91.67	93.67
T_{12}	89.67	93.33	97.00	88.33	93.00	96.67
T_{13}	93.67	96.00	98.33	89.67	95.33	98.67
T_{14}	7.00	8.23	8.36	6.35	7.33	8.00
S.Ed	7.93	7.31	4.91	7.98	6.59	5.70
CD p=0.05	12.35	10.61	9.80	13.95	12.18	11.40

HAT : Hours after treatment

Comment [GN29]: S.E or S.D?

4. CONCLUSION

~~In this present investigation, the~~ The laboratory ~~experimentation conducted on red spider mite, *Oligonychus coffeae*, using~~ tests with ~~homemade~~ crude formulations based on sesame oil and mustard oil at various concentrations, both alone and in combination with cow urine, has ~~yielded promising results. The formulations containing~~ that sesame oil at 0.5 ~~0.5%, 0.75%, and~~ 1% concentrations, ~~particularly in~~ with or without the combination with cow urine at 5%, demonstrated significant oviposition deterrent activity as well as ~~efficacy~~ ovicidal activity ~~in reducing the rate of oviposition and egg hatchability of the mites. These effects were~~ comparable to

those achieved with commercial neem-based ~~products,~~formulation.~~a widely recognized natural pesticide.~~ Moreover, the sesame oil-based formulations, especially at 0.75% and 1% concentrations ~~in conjunction with~~with or without the combination of cow urine, exhibited ~~notable~~ mortality rates for both nymphs and adult mites, comparable~~which were also on par~~ with the commercial ~~neem~~ neem-based formulation~~treatment~~. ~~These findings highlight the potential of these homemade formulations as effective and eco-friendly alternatives for managing red spider mite infestations in agricultural settings, offering a sustainable and cost-effective approach to pest control.~~ Further research and field trials may be warranted to validate and optimize these formulations for practical use in pest management strategies.

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