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Effect of different oil cakes on *Tetranychus urticae* Koch (*Acari: Tetranychidae*) in *Phaseolus vulgaris* L. under greenhouse conditions

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Abstract
The present trial was conducted to evaluate the efficacy of using five oil cakes, Cress, Rocket, Black cumin, Linseed and Parsley at different application rates on *Tetranychus urticae* Koch (*Acari: Tetranychidae*) compared to the impact of using Abamectin under greenhouse conditions. The result indicated that mentioned oil cakes were effective in suppressed the mite where, the highest reduction percentages of *T. urticae* were 85.45% and 95.94% (at 80 gm rate) by using Cress and Rocket cakes and 84.76%, 94.94% and 93.48% (at 60 gm rate) by using Black cumin, Linseed and Parsley cakes, respectively while it was 99.06% by using the acaricide. Highly significant differences were found between all treatments used with the control.

Keywords: *Tetranychus urticae*, oil cakes, reduction, greenhouse conditions

Introduction
Spider mite, *T. urticae* is an universal agricultural pest where it is a polyphagous herbivore which spreads globally and infests over 1000 host plant species on record (Bolland *et al.*, 1998) [4] including kidney bean, *Phaseolus vulgaris* L. (Santos *et al.*, 2002) [27] which representing a most important economic vegetable crops cultivated in Egypt and many countries of the world with regard to its high nutritional value as a main source of protein, in addition to its relatively easy production. Tetranychus spp. found on a wide variety of plants grown in greenhouses and open fields where it adapts to many environmental conditions as it can complete its life cycle from eggs to adults within one to two weeks under optimal conditions (Biswas *et al.*, 2004) [3].

T. urticae feeds on the leaf tissues of the host plants by piercing the parenchyma cells and sucking out its contents causing feeding-related injury reduced photosynthetic activity, water loss, and leaf wilting or abscission (Mothes and Seitz 1982 and Campbell *et al.*, 1990) [24,7], lead to severe damage to plants and huge economic losses.

Because of its high rate of reproduction and easy development of acaricides resistance (Seki, 2016 and Çağatay *et al.*, 2018) [28, 6] relying on it to suppress mite populations represents a big challenge, with observation that their excessive use causes environmental pollution and many risks to human, plant and animal life (Wilson, 1993 and Wilson *et al.*, 1991), [31, 32] in addition to its harmful effect on natural enemies. Thus, there has become an urgent need to find new, effective and safer alternatives to plant protection to avoid or reduce the potential negative effects of chemical applications.

Attention must be given to methods which improve plant health in order to increase its tolerance to pest infection, to be part of their management programs. The benefits of organic amendments in improving crops performance are well known (Gallaher and McSorley, 1994 and 1995) [10, 11] therefore a variety of organic amendments, such as oil cakes, compost, animal and green manures and proteinous wastes, are used for this purpose. Hence, oil cakes have shown great promise as a new strategy in managing nematodes (Khan *et al.*, 2004; Ashraf *et al.*, 2005; Jiskani *et al.*, 2005; Prasad *et al.*, 2005; Bora and Neog, 2006; Umar and Simon, 2008; Radwan *et al.*, 2009; El-Sherif *et al.*, 2010 and Khan *et al.*, 2011) [16, 2, 33, 25, 5, 29, 26, 9, 17] and sucking pests including mites (Mahto and Yadav 2009 a and b and Veena *et al.*, 2017). [21, 22, 30].

Accordingly, the objective of the present investigation was to examine the effectiveness of five oil cakes, Cress (*Lepidium sativum*), Rocket (*Eruca sativa*), Black cumin (*Nigella sativa*), Linseed (*Linum angustifolium*) and Parsley (*Petroselinum crispum*) at different application rates compared to the impact of using recommended acaricide, Abamectin for the management of two-spotted spider mites, *T. urticae* which infecting kidney bean under greenhouse conditions.

Materials and Methods

Chemical analysis of oil cakes under study

In order to evaluate certain oil cakes to examine their effect on the reproduction of *T. urticae* on kidney bean a greenhouse experiment was conducted.

Five various oil cakes acquired from locally grown plants were used namely Cress, Rocket, Black cumin, Linseed and Parsley. Nitrogen (N) rate was ranged from 2.28% in Rocket cake to 2.9% in each of the Parsley and Black cumin cakes, while the rate of Potassium (K) ranged from 0.2% in Parsley cake to 0.506% in Black cumin cake, which contained the highest rate of (K) 3.12%. Organic matter (O.M.) rate was 54.6% in Black cumin cake, 55.5 % in cress cake, 57.9 % in Parsley cake, 61.18% in Rocket cake and 77. 93% in Linseed cake (Table 1).

Table 1: Chemical analysis of five oil cakes under study

Oil cakes	Nitrogen (N) %	Phosphorous (P) %	Potassium (K) %	Organic matter (O.M.) %
Cress cake	2.78	0.29	2.89	55.5
Rocket cake	2.28	0.482	2.92	61.18
Black cumin cake	2.91	0.506	3.12	54.6
Linseed cake	2.41	0.411	2.88	77. 93
Parsley cake	2.9	0.2	2.86	57.9

Greenhouse experiment applications

In a greenhouse experiment, the suppression of *T. urticae* infestation by using five various oil cake treatments (Cress, Rocket, Black cumin, Linseed and Parsley) at different rates (20, 40, 60 and 80 gm) for each of them was assessed in pots in compared with Abamectin as an acaricide. Eighty eight plastic pots 15 cm in diameter and having capacity of 5 Kg soil/ pot were used to planted kidney been. Oil cakes were applied to plastic pots soil at the aforementioned rates at one time of application (seven days before seeds of kidney bean have been transplanted in pots). Plants were irrigating and weeding timely as needed.

Experiment pots were arranged in a completely randomized design with four replicates for each treatment, each replicate was represented by three plants and the same in the control (pots without treated). Through the daily examination, data of living mites that naturally infected plants during the experiment was counted and recorded at 24, 48, 72, 96, and 120 hours after acaricide application, where the number of mites in this time was ranged from one to three individuals per square inch.

Statistical analysis

Percentage of *T. urticae* reduction was estimated and corrected according to the equation of (About, 1925) [1] and all data collected were subjected to analysis of variance program (ANOVA) (Gomez and Gomez, 1984) [12] followed by Multiple Range Test to compare means (Duncan, 1955). [8]

Results and Discussion

Effect of Cress cake on spider mites, *T. urticae*

Tables (2) and (3) showed the impact of Cress cake on *T. urticae* by using different rates on application under greenhouse conditions. Results indicated that general mean reduction percentages of *T. urticae* ranged from 63.88% with using rate 20 gm to 85.45% with the use of 80 gm, where the percentage of reduction in mite population was increased with the increase in the rate used from Cress cake (Table 3) and (Fig. 1). There were highly significant differences between Cress cake rates with Abamectin and also the control (Table 2).

Effect of Rocket cake on spider mites, *T. urticae*

General mean reduction percentages of *T. urticae* by using Rocket cake were 62.45, 80.55, 91.52 and 95.94 at rates 20, 40, 60, and 80 gm, respectively where reduction percentage of mite population was increased with the increase of Rocket cake rate (Table 3) and (Fig. 1). Highly significant differences were found between all treatments used including Abamectin with the control (Table 2), where general mites reduction percentage was recorded 99.06% by using the acaricide (Table 3).

Effect of Black cumin cake on spider mites, *T. urticae*

Data represented in Table (3) and Figure (3) indicated that Black cumin cake caused the highest reduction percentage of *T. urticae* by using rate 60 gm (84.76%), whereas the least reduction percentage was 62.6% by using rate 20 gm. *T. urticae* numbers differed significantly between the different rates used of Black cumin cake as well as there were highly significant differences between these rates with Abamectin and also the control (Table 2).

Table 2: Efficiency of using different rates of oil cakes on *T. urticae* population under greenhouse conditions

Treatments		Average of mite numbers (in days) ± SEM				
Oil cakes	Rates	1 day	3 days	5 days	7 days	14 days
Cress	20 gm	6ab ± 1.870	5cde ± 1.080	4.5bcd ± 1.554	6.75b±1.796	3cd±1.080
	40 gm	5abcd ± 2.415	2.5ef ± 1.040	3.25bcdef±0.75	3.75bcdef±0.478	4.75cd±2.056
	60 gm	1.75cde ± 0.629	2.5ef ±0.957	6b ± 1.683	1.5 ±0.866	3.5cd±1.322
	80 gm	1.75cde± 0.629	1.25ef± 0.946	5bc±1.471	0.75fgh± 0.75	2.25 cd ±1.3
Rocket	20 gm	7.5ab ± 2.020	12.75b±2.926	2.25bcdef ±0.75	1.5defgh ± 0.645	4.75cd±1.03
	40 gm	5.75abc± 4.007	1.5ef ± 0.5	0.0f	3cdefgh±1.080	1.25±0.946
	60 gm	1.25cde± 0.478	0.f ± 0.5	0.ef ±0.25	2.75cdefgh±0.75	2cd ±1.22

	80 gm	0.25 de± 0.25	0.5f± 0.288	1def ± 0.577	0.0h	1.75cd±0.75
Black cumin	20 gm	4.25abcde±0.85	8.25b± 0.75	3.75bcde ±0.75	4.75bcd±1.030	11.5b±1.258
	40 gm	2.5cde ± 1.190	2ef ± 1.224	5 bc±1.471	3.5bcdefg±1.19	3cd±1.080
	60 gm	4.25abcde±1.842	0.0f	0.25bcdef ±0.25	0.25gh±0.25	5c±1.22
	80 gm	9a ± 3.937	2.75def ±1.376	2.5bcdef± 1.5	1.25efgh±0.946	3.5cd±1.44
Linseed	20 gm	1.75cde ± 0.853	0.5f ± 0.288	5bc ± 1.471	4.5bcde±1.554	1.5cd± 0.866
	40 gm	0.0e	0.75f± 0.478	2.5bcdef ± 0.645	2gefgh ±0.912	2.75cd±0.63
	60 gm	0.0 e	1.25f± 1.25	1def ± 0.707	0.75fgh±0.478	1.25cd±0.95
	80 gm	5abcd ± 1.632	0.0f	2.75bcdef ±0.946	1.25efgh±0.946	3.5cd±1.190
Parsley	20 gm	4.5abcde ± 2.217	6.25cd± 1.436	5bc ± 1.779	5.75bc±1.931	4.75cd±2.06
	40 gm	2.75bcde± 1.181	1.25f± 1.25	1.75cdef±1.181	4.5bcde±1.936	0.75cd±0.48
	60 gm	0.25de ± 0.25	0.5f ± 0.5	0.75ef ± 0.478	2.25defgh±1.314	2cd ±1.354
	80 gm	0.75de± 0.478	1f± 0.577	1.25cdef ± 0.478	1.5defgh±1.190	2cd ±1.154
Abamectin		0.25de ± 0.25	0.0 f	0.0f	0.0h	0.5c ±0.288
Control		9a± 1.080	20.75a± 3.25	14.75a±3.923	15.25a±2.625	26.5a ±4.6
LSD		4.771	3.500	3.729	3.418	4.326
F		2.891	16.260	5.940	7.476	12.843
P		.0005***	.0000***	.0000***	.0000***	.0000***

Values followed by the same letter (s) in a column are not significantly different according to Duncan's test at level 0.05.

Table 3: Efficiency of using different rates of oil cakes on the percentage reduction of *T. urticae* population under greenhouse conditions

Treatments		Redaction % (in days)					General Mean Reduction %
Oil cakes	Rates	1 day	3 days	5 days	7 days	14 days	
Cress	20 gm	33.33	75.9	69.57	55.73	84.9	63.88
	40 gm	44.44	87.9	78.02	75.4	82.07	73.5
	60 gm	80.55	87.9	59.43	90.16	86.79	80.96
	80 gm	80.55	93.95	66.19	95.08	91.5	85.45
Rocket	20 gm	16.66	38.59	84.78	90.16	82.07	62.45
	40 gm	36.11	38.55	98.3	80.32	95.28	80.55
	60 gm	86.11	92.77	98.3	81.96	92.45	91.52
	80 gm	97.22	98.79	93.23	98.3	93.39	95.94
Black cumin	20 gm	52.7	60.24	74.64	68.85	56.60	62.6
	40 gm	72.22	90.36	66.19	77.04	84.9	78.14
	60 gm	47.22	98.79	98.3	98.36	81.13	84.76
	80 gm	97.22	86.74	83.9	91.80	86.79	69.68
Linseed	20 gm	80.55	97.59	66.19	68.25	94.33	81.38
	40 gm	97.2	96.38	83.09	86.88	95.28	91.76
	60 gm	97.2	93.95	93.23	95.08	95.28	94.94
	80 gm	44.44	98.79	81.4	91.80	86.79	80.64
Parsley	20 gm	50	69.87	66.19	62.29	82.07	66.08
	40 gm	69.44	93.95	88.16	68.25	97.16	83.39
	60 gm	97.22	97.59	94.92	85.24	92.45	93.48
	80 gm	91.66	95.18	91.54	90.16	92.45	92.19
Abamectin		97.22	100	100	100	98.11	99.06

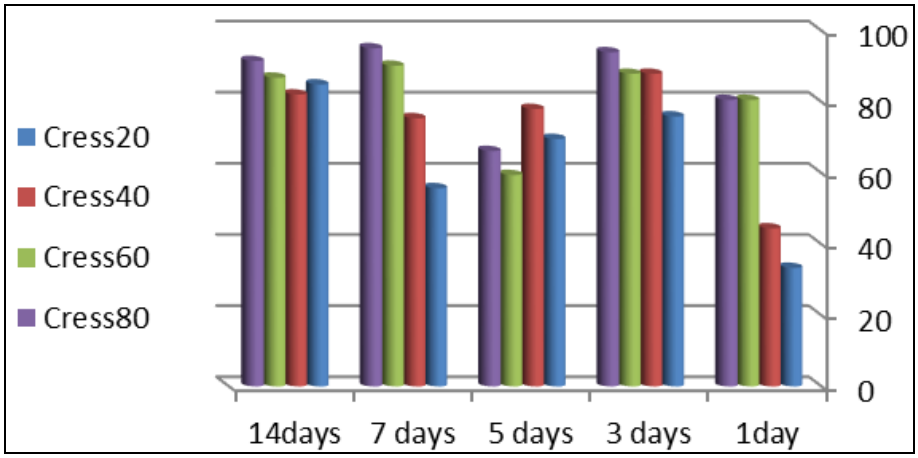

Fig 1: The efficacy of different Cress cake rates on *T. urticae* populations under greenhouse conditions

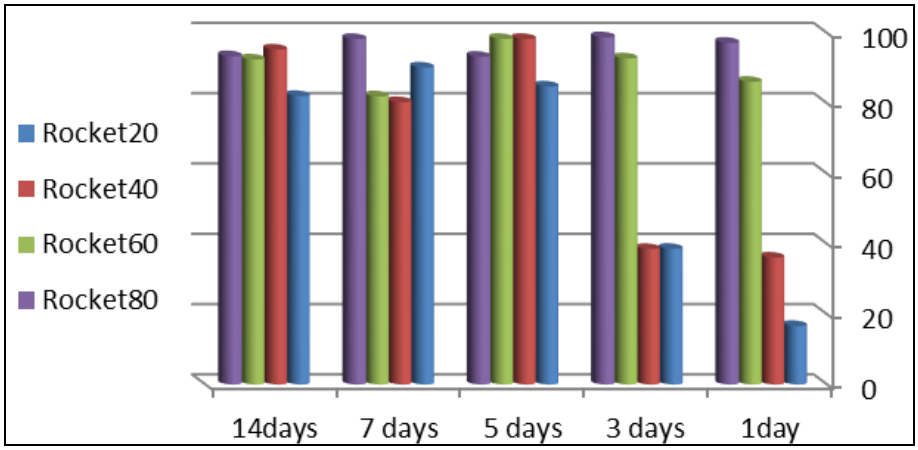

Fig 2: The efficacy of different Rocket cake rates on *T. urticae* populations under greenhouse conditions

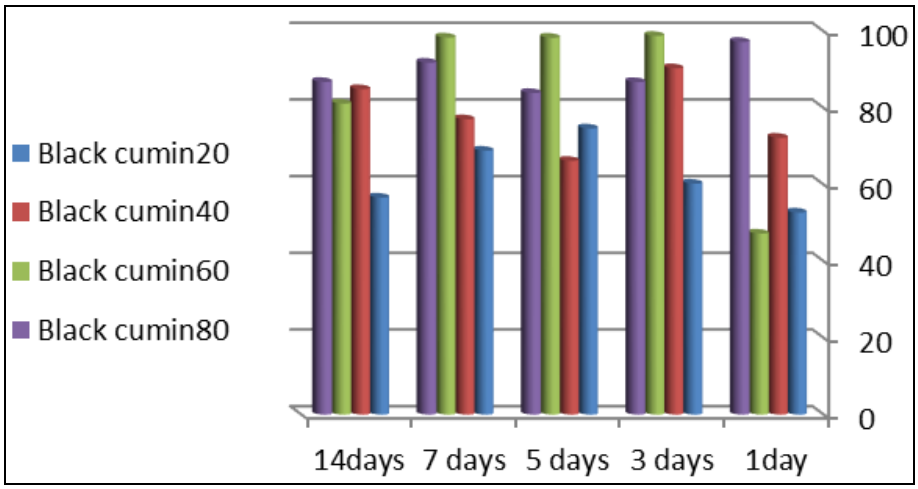

Fig 3: The efficacy of different Black cumin cake rates on *T. urticae* populations under greenhouse conditions

Effect of Linseed cake on spider mites, *T. urticae*

Data in **Table (3)** showed that the highest total reduction of *T. urticae* was recorded by using Linseed cake at rate 60 gm where it was 94.94% (Fig. 4) compared to percentage recorded by using the acaricide which was 99.06%. The mean number of mites differed significantly with the control by using various rates of Linseed cake and it also differed by treated with Abamectin (Table 2).

Effect of Parsley cake on spider mites, *T. urticae*

Results in Table (3) revealed that the use of Parsley cake at rate 60 gm caused the highest reduction percentage of *T. urticae* (93.48%), while the least effect was recorded by using 20 gm of the mentioned cake where it was 66.08% (Fig. 5). All Parsley cake rates used as treatments showed highly significant differences in the average number of mites compared to the control (Table 2).

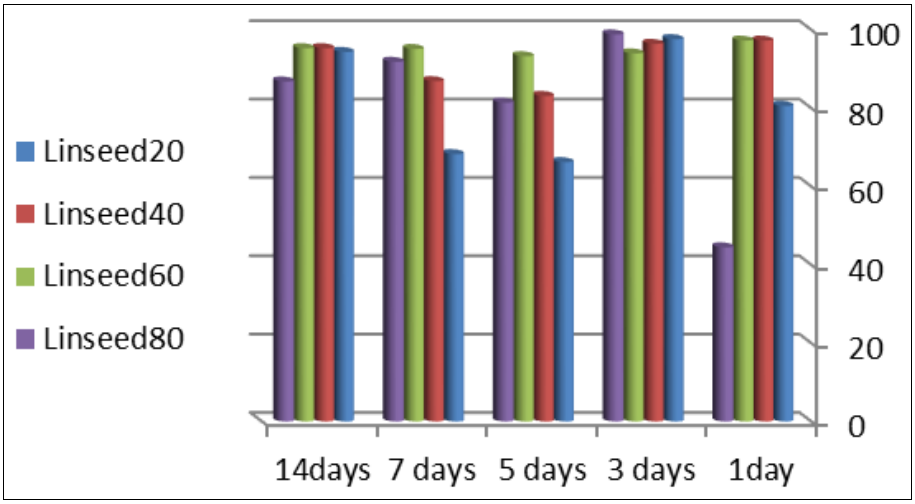

Fig 4: The efficacy of different Linseed cake rates on *T. urticae* populations under greenhouse conditions

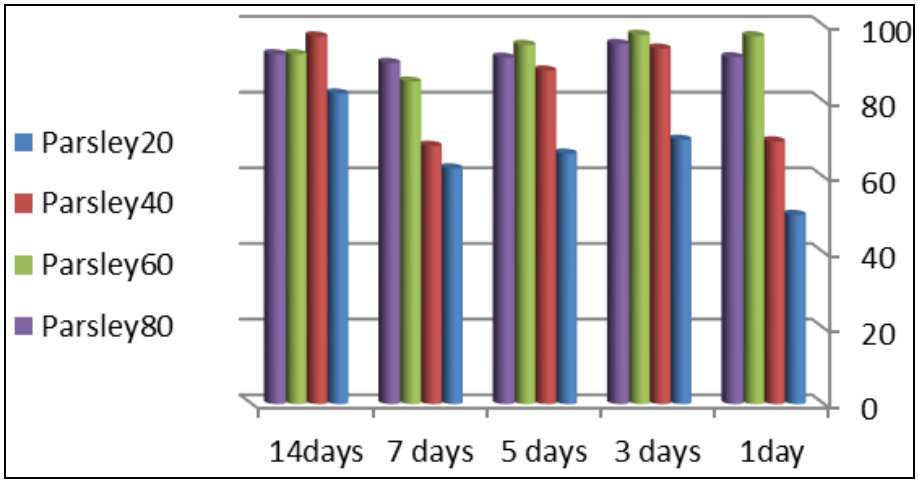

Fig 5: The efficacy of different Parsley cake rates on *T. urticae* populations under greenhouse conditions

Finally, the previous findings clearly indicated that oil cakes treatments achieved noticeable effect in suppressing mites population infesting kidney bean compared to the control under greenhouse conditions (Mahto and Yadav 2009a and b) [21, 22] where, the highest reduction percentages of *T. urticae* were 85.45% and 95.94% (at 80 gm rate) by using Cress and Rocket cakes and 84.76%, 94.94% and 93.48% (at 60 gm rate) by using Black cumin, Linseed and Parsley cakes, respectively (Table 3), while it was 99.06% by using the acaricide (Table 3). Abamectin, showed potent activity against arthropods and used to control phytophagous mites and insect pests on a variety of ornamental plants and agricultural and vegetable crops (Lasota and Dybas, 1990), [20] where it is absorbed by the foliage and affects the pest while feeding on the plant. It has been very effective for controlling spider mites on outdoor rose plants in the south-west USA (Karlik, 2003) [34]

On the other hand, the varied impact by using different rates of mentioned oil cakes was appeared through the results recorded in most treatments, where it was observed that the percentage of decrease in the number of mites was increased with the increase in the rate of cakes used (Tables 2 and 3). In a field trial, (Veena *et al.*, 2017) [30] observed the efficacy of using neem cake application to soil on suppression thrips and mites infesting chillies.

Conclusion

In conclusion, from the results obtained in the current study it showed clearly that oil cakes application achieved great success and notice effect in the suppression of mites infesting kidney bean. By reference to the benefits of organic amendments in improving crop performance a variety of organic amendments, such as oil cake, compost and animal manure are used. (Mahto, and Yadav 2009b), [21, 22] evaluated the efficacy of manuring with oilcake based vermicompost on incidence of red spider mite in okra crop and observed that vermicompost from cow dung and neem cake (4:1 & 4.5:0.5 ratios) at 1.0 kg/pot recorded relatively low mite infestation in the crop. They also studied the evidence of induced resistance against *T. urticae* in Okra plants manured with oil cake based vermicomposts (Mahto and Yadav 2009 a). [21, 22] Several previous studies showed that oil cakes have shown major promise as a new strategy in managing nematodes (Kumar *et al*., 2018; Kerakalamatti *et al*., 2020; Jena *et al*. 2021 and Mohanty 2021) [19, 18, 13, 23] and sucking pests including mites (Mahto and Yadav 2009 a, b and Veena *et al*., 2017). [21, 22, 30] Therefore, it seems that use of oil cakes can be considered as a fantastic alternative of chemical compounds. Hence, its inclusion in IPM programs in the future has required more attention.

Reference

1. Abbott WS. A method of computing the effectiveness of an insecticide. J. econ. Entomol. 1925;18(2):265-267.
2. Ashraf MS, Khan TA, Nisar S. Integrated management of reniform nematode, *Rotylenchulus reniformis* infecting okra by oil cakes and biocontrol agent *Paecilomyces lilacinus*. Pakistan Journal of Nematology. 2005;23(2):305-309.
3. Biswas GC, Islam I, Haque MM, Saha RK, Hoque KMF, Islam MS, Haque ME. Some biological aspects of carmine spider mite, *Tetranychus cinnabarinus* Boisd. (*Acari: Tetranychidae*) infesting egg plant from Rajshadhi. J. Biol. Sci. 2004;4(5):5-591.
4. Bolland HR, Gutierrez J, Flechtmann CHW. World Catalogue of the Spider Mite Family (*Acari: Tetranychidae*). Koninklijke Brill NV, Leiden, the Netherlands; c1998. p. 392.
5. Bora BC, Neog PP.Effect of oil cakes for management of *Meloidogyne incognita* in tea. Annals of Plant Protection Sciences. 2006;14(2):522-523.
6. Çağatay NS, Menault P, Riga M, Vontas J, Ay R. Identification and characterization of abamectin resistance in *Tetranychus urticae* Koch populations from greenhouses in Turkey. Crop Prot. 2018;112:112-117.
7. Campbell RJ, Grayson RL and Marini RP. Surface and ultra-structural feeding injury to strawberry leaves by the two spotted spider mite. Hort Science. 1990;25:948-951.
8. Duncan DB. Multiple range and multiple, F-test. Biometries. 1955;11:1-42.
9. El-Sherif AG, Refaei AR, El-Nagar ME, Salem MMH. Impact of certain oil-seed cakes or powder in comparison with oxamyl or urea on *Meloidogyne incognita* infecting eggplant. Archives of Phytopathology and Plant Protection. 2010;43(1/3):88-94.
10. Gallaher RN, McSorley R. Soil water conservation from management of yard waste compost in a farmer s corn field. Agronomy Research Report AY-94-02. Agronomy Department, University of Florida, Gainsville, Fl; c1994.
11. Gallaher RN, McSorley R. Effect of yard waste compost on plant- parasitic nematode densities in vegetable crops. Supplement to the Journal of Nematology. 1995;27:545-

549.
12. Gomez KA, Gomez AA. Statistical procedures for agriculture research. 2nd Ed, June Wiley &Sons. Inc. New Yourk; c1984. p. 680.
13. Jena P, Sahoo NK, Mahalik J K Effect of oil cakes and bio-agents each alone and in combination for management of Root Knot Nematode (*Meloidogyne incognita*) in Green Gram. International Journal of Bio-resource and Stress Management. 2021;12(4): 286-294.
14. Temesgen Begna, Zewdu Asrat. Evaluation of improved common bean (*Phaseolus vulgaris* L.) Varieties for yield and yield components at West Hararghe, Eastern Ethiopia. Int. J Res. Agron. 2021;4(2):50-54.
15. Alakhdar HH, Dar AA, Abd-El Rahman TA. Toxicological evaluation and residual analysis of some acaricides against two-spotted spider mite Tetranychus urticae by using certain ground spraying equipment on cotton and its intercrops in Egypt. International Journal of Entomology Research. 2021;6(1):58-67.
16. Khan A, Samad MS, Shaukat SS, Aqil T. Management of nematodes associated with date-palm using oil-cakes and carbofuran. Pakistan Journal of Nematology. 2004;22(2):129-133.
17. Khan A, Shaukat SS, Sayed M. Control of nematodes associated with almond using oil-cakes in Balochistan. Pakistan Journal of Nematology. 2011;29(2):171-177.
18. Kerakalamatti M, Mesta RK, Kiran Kumar KC, Rudresh DL. Evaluation of nematicides and oil cakes against Root Knot Nematode caused by *Meloidogyne incognita* in Pomegranate. International Journal of Current Microbiology and Applied Sciences. 2020;9(7):1763-1775.
19. Kumar A, Khilari K, Kumar Jain S, Yadav AK, Mishra AK. Efficacy of different oil cakes on management of Root Knot Nematode (*Meloidogyne graminicola*) in Rice Crop in Western Uttar Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2018;7(12):3524-3530.
20. Lasota JA, Dybas RA. Abamectin as a pesticide for agricultural use. Acta Leiden. 1990;59:(1-2):217-255.
21. Mahto TP, Yadav RP. Evidence of induced resistance against the red spider mite, *Tetranychus urticae* Koch in Okra (*Abelmoschus esculentus* (L.) Moench) plants manured with oil cake based vermicomposts. Entomon. 2009;34(3):181-184.
22. Mahto TP, Yadav RP. Effect of manuring with oil cake based vermicompost on incidence of red spider mite in okra crop. Annals of Plant Protection Sciences. 2009;17(1):40-45.
23. Mohanty SS. Effect of different oil cakes against Root Knot Nematode infecting Tomato. Journal of Emerging Technologies and Innovative Research. 2021;8(6):2349-5162.
24. Mothes U, Seitz KA. Fine structural alterations of bean plant leaves by feeding injury of *Tetranychus urticae* Koch (*Acari: Tetranychidae*). Acarologia. 1982;23:149-157.
25. Prasad JS, Varaprasad KS, Rao YR, Srinivasa Rao E, Sankar M. Comparative efficacy of some oil seed cakes and extracts against root- knot nematode (*Meloidogyne graminicola*) infection in Rice. Nematol. medit. 2005;33:191-194.
26. Radwan MA, El-Maadawy EK, Kassem SI, Abu-Elamayem MM. Oil cakes soil amendment effects on *Meloidogyne incognita*, root-knot nematode infecting tomato. Archives of Phytopathology and Plant Protection. 2009;42(1):58-64.
27. Santos D, Corlett FMF, Mendes JEMF, Wanderley Júnior JSA. Produtividadee morfologia de vagens e sementes de varie-dades de fava no Estado da Paraíba. Pesquisa Agropecuária Brasileira. 2002;37:1407-1412.
28. Seki K. Leaf-morphology-assisted selection for resistance to two spotted spider mite *Tetranychus urticae* Koch (*Acari: Tetranychidae*) in carnations (*Dianthus caryophyllus* L). Pest Manag Sci. 2016;72:1926-1933.
29. Umar I, Simon SY. The effect of oil seed cakes and ploughing against plant parasitic nematodes on cowpea (*Vigna unguiculata* (L.) Walp Agricultural Journal. 2008;3(5):349-352.
30. Veena SK, Giraddi RS, Bhemmanna M, Kandpal K. Effect of pongamia cake, neem cake and vermicompost on sucking insect pests of chilli. Journal of Entomology and Zoology Studies. 2017;5(4):775-778.
31. Wilson LJ. Spider mite (*Acari: Tetranychidae*) affect yield quality to cotton. J. Eco. Entomol. 1993;86:506-585.
32. Wilson LJ, Trichilo PJ, Gonzalez D. Spider mite (*Acari: Tetranychidae*) infestation rat and initiation impact on cotton yield. J. Eco. Entomol. 1991;84:593-600.
33. Alakhdar HH, Dar AA, Abd-El Rahman TA. Toxicological evaluation and residual analysis of some acaricides against two-spotted spider mite Tetranychus urticae by using certain ground spraying equipment on cotton and its intercrops in Egypt. International Journal of Entomology Research. 2021;6(1):58-67.
34. Karlik JF. Insects and other animals/ Insecticides. Em A. V. Roberts (Org.), Encyclopedia of Rose Science; c2003; p. 460-466. Elsevier.
35. Jiskani MM, Pathan MA, Wagan KH, Memon JA, Soomro SH. Efficacy of some biocontrol agents along with mustard cake and furadan of growth and multiplication of *Meloidogyne incognita* infecting tomato plants. Pakistan Journal of Nematology. 2005;23(1):81-86.