



Influence of farming systems on management of major pests and disease of groundnut

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Summary

A field experiment was conducted during the summer 2019 to manage significant pests and diseases of groundnut. Four farming methods were evaluated against *Aphis craccivora*, *Scirtothrips dorsalis*, *Spodoptera litura* and early leaf spot (*Cercospora arachidicola*). Among the different farming methods, Natural farming (NF) (neemastra @ 625 lit/ha) significantly reduced the *Aphis craccivora* (3.92 aphids /plant) and *Scirtothrips dorsalis* (11.80%) at one week after spray followed by organic farming (OF) and a package of practice (POP). Similarly, *S. litura* (0.44 % leaf damage) infestation was significantly lower at two weeks after spray compared to other treatments. Botanical decoctions were found safer to *Coccinella transversalis* in natural farming plot. The experiment also evaluated the effective farming methods against early leaf spot of groundnut and among the different methods, the minimum per cent disease index (6.26) was recorded in POP (hexaconazole 5EC @ 500ml/ha) followed by OF (azadirachtin 10000 ppm @ 600ml/ha) (7.02) and NF (fermented buttermilk @ 12.50 lit/ha) (7.19). All the farming methods were statistically at par in recording pod yield however, the highest pod yield was recorded in POP (20.07 q/ha) followed by organic farming (19.50 q/ha). The present investigation has found natural farming to be an effective system against the management of pests and disease in groundnut.

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Introduction

In India, groundnut (*Arachis hypogaea* L.) is one of the most promising oilseed crops grown in an area of 49.14 lakh ha which accounts for 82.54 lakh tonnes with a productivity of 1679 kg/ha. In Karnataka, groundnut was grown in about 5.41 lakh ha with 5.02 lakh tonnes of production and 863 kg /ha productivity.^{2, 21} Among the several factors responsible for low productivity in groundnut, the major threat to groundnut cultivation is the widespread attack by insect pests and diseases.^{11, 19} The major insect pest of groundnut is aphid (*Aphis craccivora* Koch), leaf miner (*Aproaerema modicella*), white grub (*Holotrichia consanguinea* Blanchard), tobacco caterpillar (*Spodoptera litura* Fab.), red hairy caterpillar (*Amsacta albistriga* Butler), jassid (*Empoasca kerri* Pruthi), thrips (*Scirtothrips dorsalis*).^{4, 14, 20} Major diseases that affect groundnut crop are fungal diseases like early leaf spot (*Cercospora arachidicola* Hori.), late leaf spot (*Phaeoisariopsis personata* Berk. and Curt.), and rust (*Puccinia arachidis* Speg.). Among these, the leaf spot disease, known as "Tikka," occurs severely during warm

and humid period.^{6, 22} Leaf spots damage the plant by reducing the available photosynthetic area due to a lesion formation and stimulating leaflet abscission. Worldwide, the yield losses range up to 50 per cent in the absence of the fungicide spray.⁸ Pest and disease management has assumed greater importance in increasing agricultural production. Environment-friendly management is necessary to reduce yield loss due to pests and diseases in groundnut and increasing public concern over pesticide residues in the food. By considering these factors, the present study was carried out to evaluate the efficiency of natural and organic farming methods to manage *A. craccivora*, *Scirtothrips dorsalis*, *S. litura* and *C. arachidicola* and its impact on *Coccinella transversalis* of groundnut.

Materials and Methods

Field studies

The experimental trials were conducted at the Zonal Agricultural and Horticultural Research Station (13° 96' N latitude and 75° 58' E longitude with an altitude of 650 MSL) KSNUAHS, Shivamogga, India during summer 2019, to assess the effect of farming methods on the management of insect pests (*A. craccivora*, *Scirtothrips dorsalis* and *S. litura*) and diseases (*C. arachidicola*) in groundnut. The crop was raised with appropriate agronomic practices with plot size of 35×4m having row-to-row and plant-to-plant spacing of 30 cm and 10 cm respectively.

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Management of insect pests of groundnut

The experiment was conducted under Randomized Complete Block Design (RCBD) with four treatments viz., T1- Natural Farming (neemastra @ 625 lit/ha*), T2- Organic farming (azadirachtin 10000 ppm @ 600ml/ha), T3- Package of practice (imidacloprid 17.8 SL @ 250ml/ha) and T4- Control. These treatments were used for the management of insect pests in groundnut ecosystem.

The first spray was imposed at 30 days after sowing when the pest population rose above the economic threshold level (aphids-5-10 aphids/terminal seedling stage, thrips-5 adults/terminal buds, and *S. litura* 2 larvae/plant or 20-25% defoliation).¹⁵ The treatments were sprayed with knapsack sprayer using a spray fluid of 500litre/ha. Spraying was carried out in the evening hours with low wind velocity.

The observation of the defoliator like *S. litura* was recorded one day before spraying as a pre-treatment count, 7, 14 and 30 days after spraying as post-treatment counts and per cent infestation/ damage was worked out. The data were subjected to arcsine transformation followed by ANOVA. The population of aphids (*A. craccivora*) and thrips (*S. dorsalis*) were recorded from the top, middle, and bottom trifoliate leaves per plant from 5 randomly selected plants of each plot by tagging the leaves. The observation of the sucking pest

population was recorded one day before spraying as pre-treatment count 3 and 7 days after spraying as post-treatment counts. The data were subjected to square root and arcsine transformation followed by ANOVA.

*Preparation of Neemastra: Crushed 5 kg neem leaves in water to this added 5 lit desi cow urine (breed: malnad gidda) and 2 kg cow dung left it for 24 hours for fermentation with intermittent stirring, filter the extract and diluted to 100 litre of water.³

Management of diseases of groundnut

Treatment details are as follows; T1- Natural Farming (fermented buttermilk[#] @ 12.50 lit/ha), T2- Organic farming (azadirachtin 10000 ppm @ 600ml/ha), T3- Package of practice (hexaconazole 5EC @ 500ml/ha) and T4- Control.

Botanicals and fungicides were applied thrice during 30, 45 and 60 days after sowing (DAS) against early leaf spots. Per cent disease index of the early leaf spot of the groundnut was calculated by taking ten plants randomly from each plot, and pre-treatment observation was recorded one day before the imposition of treatment. Post-treatment observations were recorded at 15 days intervals after the imposition of treatment and disease severity was recorded using a modified 9-point scale.¹⁶ The per cent disease index was calculated using the formula¹⁸, and the data were subjected to arcsine transformation followed by ANOVA.

$$PDI = \frac{\text{Sum of individual ratings}}{\text{Total number of leaves observed} \times \text{Maximum disease score}} \times 100$$

[#]Preparation of fermented buttermilk: Five litres of buttermilk are fermented for five days. Dilute the fermented buttermilk in 200 litres of water.

Results and Discussion

Evaluation of different farming methods against insect pests of groundnut

The lowest aphid population was recorded in a recommended package of practices (imidacloprid 17.8 SL @ 250ml/ha) at 3 and 7 days after spraying compared to other farming methods. Among the four farming methods recommended, a package of practices (imidacloprid 17.8 SL @ 250ml/ha) recorded the significantly, lowest aphid population (4.43 aphids/ no. of aphids from apical portion/plant) three days after spray. However, the highest aphid population was recorded in the control plot (11.52 aphids/ no. of aphids from the apical portion/plant). At 7 days after spray, the lowest number of aphids (3.92) was recorded from NF (neemastra @ 625 lit/ha) followed by POP (imidacloprid 17.8 SL @ 250ml/ha) (4.45). Whereas, the highest number of aphids (11.19) was recorded from the control (Table 1).

Against the thrips, at 3 days after spray, the lowest leaf damage (13.80 %) was recorded in the

recommended package of practices (imidacloprid 17.8 SL @ 250ml/ha) followed by NF (neemastra @ 625 lit/ha) and organic farming (azadirachtin 10000 ppm @ 600ml/ha) (15.60 %). At 7 days after spray lowest leaf damage (11.80 %) was recorded in NF, followed by a recommended package of practices (14.40 %) and organic farming (14.60 %) (Table 1).

The present study showed 7, 14 and 30 days after spray, NF (neemastra @ 625 lit/ha) showed high effectiveness against *S. litura*. The results revealed that all the treatments were significantly superior over control. At 7 days after spray significantly lowest per cent of leaf damage was recorded in NF (neemastra @ 625 lit/ha) (0.72 %) followed by organic farming (azadirachtin 10000 ppm @ 600ml/ha) (0.83 %). At 14 days after spray lowest per cent of leaf, damage was recorded in NF (0.44 %) followed by organic farming (0.93 %). At 30 days after spray lowest per cent of the leaf, the damage was recorded in NF (0.77 %) followed by organic farming (0.19 %) (Table 1).

Table 1. Efficacy of botanicals and insecticides against *A. craccivora*, *S. dorsalis* and *S. litura* in groundnut under different farming methods

Treatments	<i>A. craccivora</i> (no. of aphids from apical portion/plant) *			<i>S. dorsalis</i> (% damage) **			<i>S. litura</i> Per cent leaf damage **			
	DBS	3 DAS	7 DAS	DBS	3 DAS	7 DAS	DBS	7 DAS	14 DAS	30 DAS
T₁- Natural Farming	8.16 (2.94)	8.49 (3.00) ^b	3.92 (2.10) ^d	15.20 (22.92)	15.60 (23.21) ^a _b	11.80 (20.07) ^b	0.68 (4.72)	0.72 (4.86) ^b	0.44 (3.80) ^c	0.77 (5.03) ^c

T₂- Organic Farming	8.09 (2.93)	7.90 (2.90) ^b	5.19 (2.39) ^b	17.60 (24.77)	15.60 (23.21) ^a	14.60 (22.40) ^b	0.71 (4.83)	0.83 (5.21) ^b	0.93 (5.52) ^b	1.19 (6.27) ^b
T₃- Recommended Package of practice	8.04 (2.92)	4.43 (2.22) ^c	4.45 (2.2) ^c	16.80 (24.16)	13.80 (21.79) ^a	14.40 (22.26) ^b	0.63 (4.55)	0.97 (5.66) ^b	1.12 (6.09) ^b	1.21 (6.32) ^b
T₄- Control	8.72 (3.04)	11.52 (3.47) ^a	11.19 (3.42) ^a	18.60 (25.54)	17.60 (24.79) ^b	17.60 (24.78) ^a	0.73 (4.89)	1.69 (7.47) ^a	1.87 (7.85) ^a	2.50 (9.09) ^a
SEM±	0.12	0.07	0.08	0.68	0.71	0.74	0.44	0.52	0.73	0.83
CD @5%	NS	0.23	0.26	NS	2.19	2.29	NS	1.60	2.24	2.57

* Figures in the parentheses are average of transformed values = $\sqrt{X+0.5}$; ** Figures in the parentheses are arcsine transformed values DBS- Day before spraying, Significant at $p<0.05$; Means followed by common letters are not significantly different by DMRT test

The results revealed that a significantly higher population of *C. transversalis* (0.88 and 1.00 numbers per plant) was noticed in the NF and organic farming plot at 3 days after spray, respectively. Similarly, 7 days after spray, a higher population of ladybird beetle was recorded in NF (0.90 numbers per plant) followed by organic farming (1.00 numbers per plant) (Table 2). The aphid population was drastically reduced in experimental plots irrespective of treatments may be due to the increased activity of coccinellids and also by climatic factors of the locality viz., temperature and relative humidity. It indicated no adverse effect on the population of natural enemies in natural farming and organic farming treatments. However, control plots continued to record with the highest pest incidence and found to be

significantly inferior to the remaining treatments. Aphid, thrips and *S. litura* damage was reduced significantly in NF neemastra applied plots due to feeding deterrent and communication disruption. Kavitha and Patil (2009)⁷ reported that fermented plant products and aqueous extracts of NSKE (5%) spray recorded significantly less number of defoliator larvae in the groundnut. Application of agniastra, brahmastra and neemastra effectively reduces cotton-sucking pests and defoliators.²¹ The neem extract and neem oil reduced 73-83% aphid population in the mustard crop in Bangladesh (Biswas 2008).⁵ Morde and Blackwell (1993)¹⁰ reported that neem products act as an antifeedant, repellent and insect growth retardant, which can be used for insect management.

Table 2. Activity of *C. transversalis* (grubs and adults) in groundnut

Treatments	<i>C. transversalis</i> (numbers/plant)		
	DBS	3 DAS	7 DAS
T1- Natural Farming	1.03 (1.24)	0.88 (1.17) ^b	1.03 (1.24) ^b
T2- Organic Farming	1.00 (1.23)	0.90 (1.18) ^b	1.00 (1.23) ^b
T3-Recommended Package of practice	0.47 (0.98)	0.41 (0.95) ^c	0.47 (0.98) ^c
T4- Control	1.44 (1.39)	1.17 (1.29) ^a	1.44 (1.39) ^a
SEM±	0.06	0.06	0.04
CD @5%	NS	0.18	0.14

Figures in the parentheses are average of transformed values= $\sqrt{X+0.5}$; DBS- Day before spraying, DAS- Days after spraying; *Significant at $p<0.05$; Means followed by common letters are not significantly different by DMRT test

In the present study, botanical insecticides significantly reduced insect pests and diseases of groundnut in two weeks after spray and conveniently maintained ecological balance with natural enemies. This helps increase natural enemies' population in natural and organic farming plots. Botanical insecticides have various chemical properties, different modes of action and the highest biological activity and affect the insects in different ways viz., antifeedants, repellents, toxicants, growth retardants, chemosterilants and inhibition of oviposition, egg hatching and moulting. The reduced efficacy of botanicals used in the study may be due to their swift biodegradable nature, less dispersion of the active compounds under field conditions and prevailing weather conditions. Botanical insecticides are safer than

beneficial natural enemies and affect only target insects, providing residue-free food and a safe environment.

Evaluation of different farming methods against early leaf spot of groundnut

All the treatments effectively managed the early leaf spot of groundnut compared to the untreated control. However, the per cent disease index of early leaf spot was recorded minimum in a recommended practice package with the highest per cent reduction over control (Table 3). All the treatments significantly reduced the disease compared to untreated control. However, the minimum per cent disease index was recorded in a recommended package of practice (hexaconazole @ 0.1%), followed by organic farming (neem oil 3000 ppm @ 3%). Vyavhare et al. (2020)¹⁷ also reported that hexaconazole is superior to other treatments. Aage et al.

(2003)⁷ reported that spray of aqueous leaf extract of *Azadirachta indica* was highly influential in suppressing leaf spot disease intensity in groundnut. Natural farming (fermented buttermilk* @ 12.50 lit/ha) showed the highest per cent disease index, possibly due to the slow

mode of action of natural products compared to chemicals. The frequent application of fermented buttermilk also reduced the fungal growth in groundnut crop.

Table 3. Effect of different farming practices on management of early leaf spot of groundnut (*C. arachidicola*)

Treatments	DBS (30DAS)	Per cent disease index			Reduction over control (%)	Pod yield (q/ha)
		15 days after 1 st spray	15 days after 2 nd spray	15 days after 3 rd spray		
T1- Natural Farming	5.82 (13.92)*	5.95 (14.08)	6.39 (14.64)	7.19 (15.32)	53.70	18.83
T2- Organic Farming	5.37 (13.39)	5.46 (13.50)	5.91 (14.06)	7.02 (15.20)	54.79	19.50
T3-Recommended Package of practice	5.06 (13.00)	5.11 (13.06)	5.46 (13.51)	6.26 (14.38)	59.69	20.07
T4- Control	5.99 (14.16)	10.13 (18.50)	13.11 (21.21)	15.53 (23.20)	-	18.57
S.EM±	0.32	0.51	0.29	0.76		
C.D. @ 5%	NS	1.58	0.90	2.35		

Figures in the parentheses are arcsine transformed values; DBS- Day before spraying, *Significant at $p < 0.05$; Means followed by common letters are not significantly different by DMRT test

The eco-friendly nature of botanical insecticides recently gains more importance. Therefore, biopesticides will become alternatives to synthetic insecticides because of their lower cost, safety and widespread availability.¹³ Therefore, biopesticides are a more rational choice for managing insect pests, especially as an improved balance between cost and efficiency becomes a reality in the near future.⁸

Conclusion

Based on the results, it can be concluded that natural farming treatment (neemastra @ 625 lit/ha), significantly reduced damage caused by *A. craccivora*, *S. dorsalis* and *S. litura*. The minimum per cent of disease index was recorded in POP (hexaconazole 5EC @ 500ml/ha). Package of practice recorded, highest pod yield which is statistically at par with organic farming and natural farming methods.

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Declaration of interests

The authors have no conflict of interest to declare.

Data Sharing

All relevant data are within the manuscript.

References

1. Aage VE, Gaikwad SJ, Behere GT & Tajame VS. 2003. Efficacy of extracts of certain indigenous medicinal plant against *Cercospora* leaf spot of groundnut. *Journal Soils and Crops*, 13(1):140-144.
2. Anonymous 2022. Directorate of Economics and Statistics, Government of India. New Delhi.
3. Arora S, Sharma JP, Chakravorty S, Sharma, N & Pratibha J. 2016. Indigenous Technologies in Plant Protection. ICAR-NCIPM, Pusa Campus, New Delhi.
4. Atwal AS & Dhaliwal GS. 2008. Agricultural pests of South Asia and their management. Kalyani Publishers, Ludhiana.
5. Biswas GC. 2008. Efficacy of some plant materials against the mustard aphid, *Lipaphis erysimi* (Kalt.). *Journal of the Asiatic Society of Bangladesh*, 34 (1):79-82.
6. Jha A, Tiwari S & Kumar A. 2013. Effect of biopesticides and fungicides on tikka disease of groundnut (*Arachis hypogaea* L.). *International Journal of Plant Protection*, 6(2):425- 427.
7. Kavitha AS & Patil RK. 2009. Eco-friendly practices against major pests in different cropping systems with special reference to groundnut. Abstracts of Thesis, Karnataka.
8. Kokalis-Burelle N, Porter DM, Rodríguez-Kábana R, Smith DH & Subrahmanyam P. 1997. Compendium of peanut diseases. *American Phytopathological Society*, USA.
9. Lukmanul HS & Usman SFT. 2020. Biopesticides as Promising Alternatives to Chemical Pesticides: A Review of Their Current and Future Status. *OnLineJournal of Biological Sciences*, 20 (2): 66-76.
10. Morde AJ & Blackwell K. 1993. Azadirachtin: an update. *Journal of Insect Physiology*, 39(11): 903-924.
11. Nwokolo E. 1996. Peanut (*Arachis hypogaea* L.). In *Food and feed from legumes and oilseeds*, Springer, Boston, MA.
12. Patel RD, Bharpoda TM, Borad PK, Bhatt NA & Mahida RD. 2017. Efficacy of different bio-pesticides against sucking pests of bt cotton. *AGRES – An International e-Journal*, 6(1): 171-180.
13. Pavela R. 2007. Possibilities of botanical insecticide exploitation in plant protection. *Pest Technology*, 1: 47-52.
14. Rahman SM, Vijayalakshmi K, Durga Rani V, Ameer Basha S & Srinivas C. 2021. Survey on major insect pests of groundnut in Southern Telangana zone. *The Pharma Innovation Journal*, 10(9): 291-296.
15. Singh S, Thirumalaisamy PP, Harish G, Datta R, Sushil SN, Sinha AK, Ram A, Kapoor KS, Satyagopal K, Jeykumar P, Ajanta B, Sharma OP, Someshwar B, Verma PV, Sunil K, Chattopadhyay C & Yadav MS. 2014. Integrated pest management package for groundnut. pp.49.
16. Subramanyam PD, Mc Donald, Waliyar F, Reddy LJ. 1995. Screening methods and sources of resistance to rust and late leaf spot of groundnut. Information Bulletin No. 47, ICRISAT, Patancheru, Andhra Pradesh, India, pp: 19.
17. Vyavhare YV, Khaire PB & Mane SS & Joshi MS. 2020. Efficacy of different triazole fungicides in reducing combined incidence of early leaf spot, late leaf spot and rust diseases of groundnut. *Journal of Pharmacognosy and Phytochemistry*, 9(5):593-596.

18. Wheeler, B. E. J. (1969), An introduction to plant diseases, John Willey and Sons Ltd, London, 301.
19. Bana RS, Dawar Rakesh, Haldhar SM, Godara S, Singh A, Bamboriya SD, Kumar V, Ishra AK & Choudhary M. 2022. Natural farming: Is it safe to march ahead? *Journal of Agriculture and Ecology*, 14: 01-11.
20. Haldhar SM, Jat GC, Deshwal H, Gora JS & Singh D. 2017. Insect pest and disease management in organic farming. Book 'Towards Organic Agriculture' edited by B. Gangwar and N. K. Jat. Today & Tomorrow's Publishers, New Delhi, Page: 359-390, ISBN: 81-7019.
21. Sarangthem I, Haldhar SM, Mishra LK & Thakuria D. 2023. The book of abstract: international conference on natural farming for revitalizing environment and resilient agriculture (NF-RERA, 2023). Pub: College of Agriculture, CAU, Imphal, pp: 374, ISBN: 978-81-947184-4-4.
22. Nazir R, Sayedi SA, Zaryal K, Khaleeq K, Godara S, Bamboriya SD & Bana R. 2022. Effects of phosphorus application on bunch and spreading genotypes of groundnut. *Journal of Agriculture and Ecology*, 14: 26-31. <https://doi.org/10.58628/JAE-2214-24>.