Eco-Friendly IPM Approaches for the Management of Sucking Pest Complex and Defoliators in Groundnut of Mancherial District, Telangana State

Abstract:

The present front line demonstration was conducted to demonstrate the effectiveness of Integrated Pest Management module in Groundnut crop cultivated in the Mancherial district of Telangana State during *rabi* seasons of 2022-23 and 2023-24. Groundnut is often referred to as the "King of Oilseeds" in India, where it ranks as the second-largest producer of groundnut globally. However, groundnut cultivation faces considerable yield losses each year due to various biotic and abiotic stresses, which significantly hinder the groundnut productivity in the country. Now a days, the adoption of management of groundnut insect pests through integrated pest management (IPM) strategies has increased, particularly due to the adverse effects associated with the indiscriminate use of insecticides alone. The study recorded the percentage control of leaf hoppers, thrips, leaf minor and *Spodopteralitura* compared to farmer's practice. The results revealed that the superior percent reduction i.e., in the incidence of jassids in the IPM demonstrated plots at 16.77% and 26.58%, in case of thrips @ 13.81% and 19.47% and in case of leaf minor@39.7% and 48.5% and in case of *Spodoptera* @ 23.03% and 47.19% over farmers practice with increased yields of 16.79% and 13.10% during corresponding *rabi* seasons of 2022-23 and 2023-24 respectively. Further, the demonstration plots registered with higher groundnut yield of 3050 and 3020 kg/ha as compared to 2611 and 2670 kg/ha under farmers practice. The Cost-Benefit ratio of 2.92 and 3.15 respectively in the technology demonstrated plots whereas in farmers practice the recorded Cost - Benefit ratio of 2.18 and 2.47 during corresponding *rabi* seasons of 2022-23 and 2023-24 respectively. The findings suggest that the groundnut cultivated under IPM practices yields more than those grown using traditional methods. The IPM approach, encompassing all stages from tillage to harvest, enhances yield, improves input use efficiency, and provides greater economic benefits.

Key Words: Groundnut, Integrated Pest Management, Front Line Demonstration (FLD), Sucking Pest Complex and Defoliaters

Introduction:

Groundnut, scientifically known as *Arachis hypogea* L., plays a vital role as an oilseed crop in India, thriving across *kharif, rabi, and summer* seasons under rain-fed/irrigated condition. India ranks first globally in groundnut cultivation, with an area covering of 54.20 lakh hectares, and holds the second position in production, yielding 101.00 lakh tonnes, with a productivity rate of 1863 kg per hectare for the year 2021-22 (Yadav et al., 2023). This crop contributes approximately 37% to the total oilseed production in the country. In Telangana, groundnut has been cultivated in an area of 6859.2 hectares, achieving a productivity of 2050 kg per hectare (Groundnut Outlook, PJTSAU, 2023).Over 100 species of insects and mites are recognized as pests of groundnut. Research has shown that preventable yield losses caused by significant insect pests can amount to 48.57 percent in pods and 42.11 percent in fodder (Dabhade et al., 2012). The low productivity of groundnut is primarily attributed to insect pests such as the leaf miner, tobacco caterpillar, thrips, and leafhoppers, which contribute to yield losses ranging from 24 to 92 percent, 16 to 42 percent, 17 to 40 percent, and 9 to 22 percent, respectively. Additionally, these pests indirectly affect crops by acting as vectors for viral diseases (Atwal and Dhaliwal, 2008). The reliance of

farmers on chemical pesticides has had detrimental effects on the environment and has led to issues such as pest resurgence and resistance to insecticides. A notable disparity between potential and actual yields in groundnut production has been identified, primarily due to the impact of destructive pests, diseases, and abiotic factors (Ahir et al., 2018). Farmers often perceive chemical pesticides as the most effective means of pest control; however, their indiscriminate application can adversely affect beneficial insects, human health, and the environment (Harish et al., 2015). The preventable yield loss attributed to major insect pests in groundnut has been documented at 48.57 percent for pods and 42.11 percent for fodder. Insufficient technical knowledge regarding integrated pest management techniques can lead to increased pest infestations and crop losses, ultimately diminishing overall yield. Frontline demonstrations (FLDs) have proven to be an effective approach for promoting innovative practices across extensive areas of farmers' fields, thereby raising awareness of sustainable crop production technologies at minimal costs (Amuthaselvi et al., 2023). As a result, this study was undertaken to develop and implement the Integrated Pest Management (IPM) practices through FLD in the Mancherial district to demonstrate the most effective module in farmers' fields and compare its performance against traditional farming practices.

Materials and Methods:

The Integrated Pest Management (IPM) module was implemented at ten distinct locations within the farmer fields during *rabi* season of2022-23 and 2023-24, encompassing an area of 0.40 hectares (1 acre) at each site, alongside a control group that showcased traditional farming practices.Observations regarding pest population dynamics were meticulously recorded throughout the crop season, commencing 15 days post-transplanting and concluding 15 days prior to harvest. The IPM module incorporated several strategies, including summer deep ploughing, the planting of trap crops such as soybean for leaf miners and castor for tobacco caterpillars, the collection and destruction of tobacco caterpillar egg masses, and the installation of pheromone traps at a density of 4-5 per acre for both tobacco caterpillars and groundnut leaf miners. Furthermore, bird perches were installed at a rate of 10 per acre, and seed treatment with imidacloprid at 2 ml/kg was applied. Spraying of Bio-pesticides like Azadiractin 1500ppm @ 1 lit /acre and need based spraying of insecticides like Novaluron @ 1ml or Emmamectin benzoate @ 0.5g or Chloranthranoliprole @ 0.3 ml/lit of water and in contrast, Chlorpyrifos at 2-2.5 ml/l, Acephate at 2 g/l, Monocrotophos at 1.8 ml/l, and Cypermethrin at 1.5 ml/l. A total of 20 No. of plants were randomly selected and tagged from both the demonstration and farmer practice plots at each location. The population dynamics and incidence of leaf hoppers, *Empoascakerri* (Pruthi), thrips, *Scirtothrips dorsalis* (Hood), leaf miner, *Aproaeremamodicella* (Deventer) and *Spodopteralitura*were measured in comparison to untreated control and the percentage reduction in pest population compared to the farmer's practices was determined by using the formula Ramadevi et al. (2020).

$$\text{Population reduction (\%)} = \left(\frac{Xi - Xo}{Xi}\right) x100$$

Where:
Xi = Number of pest population/leaf damage in farmer practice
Xo = Number of pest population/leaf damage in demonstration plot.

Results and Discussion:

The effectiveness of integrated pest management (IPM) components is evidenced by the observation that IPM fields experienced considerably lower levels of insect pest damage compared to farmer practice (FP) fields (Table 1).

Jassids:

The average No. of jassids1.8 and 2.19 per top 3 leaves during the *rabi*, 2022-23 and 2023-24 respectively with two years average of 1.99 in the IPM demonstrated plots whereas in farmers practice the average No. of jassids 2.19 and 2.98 with two years average of 2.58 withthe percent reduction inthe incidence of jassids in the demonstrated plot over farmer's practice 16.77% and 26.58% with two years average of 30.06%. (Table 1 & 2).

Thrips:

The average No. of thrips 1.68 and 2.34 on the terminal bud during the *rabi*, 2022-23 and 2023-24 respectively with two years average of 2.01 in the IPM demonstrated plots whereas in farmers practice the average No. of thrips 1.96 and 2.92 with two years average of 2.44 with the percent reduction in the incidence of thrips in the demonstrated plot over farmer's practice 13.81% and 19.17% with two years average of 16.49%. (Table 1 & 2).

Leaf Minor:

The average No. of damaged leaves by leaf minor 1.57 and 1.77 on the top three leaves during the *rabi*, 2022-23 and 2023-24 respectively with two years average of 1.67 in the IPM demonstrated plots whereas in farmers practice the average No. of damaged leaves 1.85 and 2.53 with two years average of 2.19 with the percent reduction in the incidence of leaf minor in the demonstrated plot over farmer's practice 39.7% and 48.5% with two years average of 44.1%. (Table 1 & 2).

Tobacco Caterpillar:

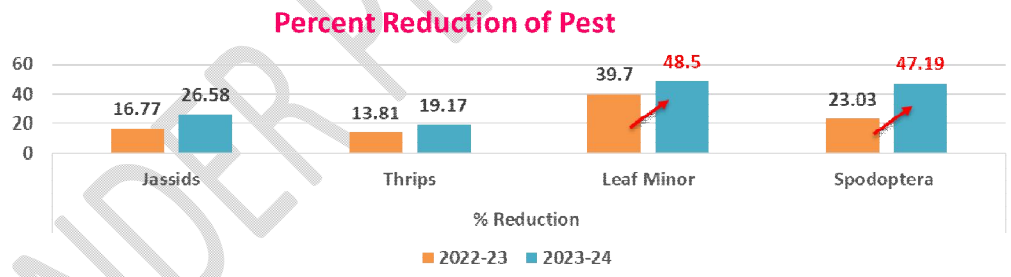
The average No. of damaged leaves by tobacco caterpillar 1.07 and 1.34on the top three leaves during the *rabi*, 2022-23 and 2023-24 respectively with two years average of 1.20 in the IPM demonstrated plots whereas in farmers practice the average No. of damaged leaves 1.48 and 2.52 with two years average of 2.00 with the percent reduction in the incidence of tobacco caterpillar in the demonstrated plot over farmer's practice 23.03% and 47.19% with two years average of 35.11%. (Table 1 & 2).

Similar findings were documented by Kandakoor (2012), Roshan et al. (2016), and Seetharamu et al. (2020).

Table: 1 - Results of Integrated Pest Management module in groundnut crop during *rabi*, 2022-23													
Month	**Demo**					**Check**				**% Reduction**			
	Pest Population / Leaf / Plant					**Pest Population / Leaf / Plant**							
	Jassids	**Thrips**	**Leaf Minor**	**Spodoptera**	**Avg. Trap Catches**	**Jassids**	**Thrips**	**Leaf Minor**	**Spodoptera**	**Jassids**	**Thrips**	**Leaf Minor**	**Spodoptera**
November	1.8	1.23	0.93	0.73	6.25	1.93	1.37	1.07	0.87	6.74	10.22	31.78	16.09
December	1.43	1.5	1.33	1.07	10.5	1.7	1.77	1.57	1.1	15.88	15.25	31.85	2.73
January	2.27	1.93	2.13	1.37	5.75	2.63	2.27	2.53	1.9	13.69	14.98	45.85	27.89
February	1.73	2.07	1.9	1.13	7.5	2.5	2.43	2.23	2.07	30.8	14.81	49.33	45.41
Average	**1.8**	**1.68**	**1.57**	**1.07**	**7.5**	**2.19**	**1.96**	**1.85**	**1.48**	**16.77**	**13.81**	**39.7**	**23.03**

Table: 2 - Results of Integrated Pest Management module in groundnut crop during *rabi*, 2023-24													
Month	**Demo**					**Check**				**% Reduction**			
	Pest Population / Leaf / Plant					**Pest Population / Leaf / Plant**							
	Jassids	**Thrips**	**Leaf Minor**	**Spodoptera**	**Avg. Trap Catches**	**Jassids**	**Thrips**	**Leaf Minor**	**Spodoptera**	**Jassids**	**Thrips**	**Leaf Minor**	**Spodoptera**
October	1.87	2.03	1.17	0.9	7.75	2.47	2.1	2.07	1.67	24.32	3.17	56.45	46
November	2.73	2.47	1.63	1.27	12.25	3.03	3.4	2.43	3.07	9.89	27.45	47.95	58.7
December	1.6	1.77	1.37	1.07	6.5	2.93	2.73	2.4	2.3	45.45	35.37	55.56	53.62
January	2.57	3.07	2.9	2.13	5.5	3.5	3.43	3.23	3.07	26.67	10.68	34.02	30.43
Average	**2.19**	**2.34**	**1.77**	**1.34**	**8.00**	**2.98**	**2.92**	**2.53**	**2.53**	**26.58**	**19.17**	**48.5**	**47.19**

Fig .1 Percent Reduction of Pest



Yield impact:

The information regarding the impact of technology demonstrated in terms of escalation in yield have been presented in table 3. The data revealed that, the groundnut pod yield improved by 16.79% and 13.10% during *rabi*, 2022-23 and 2023-24 respectively with an average of 14.95% increased yields in the demonstrated plots as compared to farmer's practice. In all the two years, the demonstration plots showed significant differences in the yields against farmers practice.

Economic impact:

The economic indicators, including total cultivation costs, gross returns, net returns, and the benefit-cost (B:C) ratio, were evaluated to assess the economic effects of integrated pest management (IPM) practices compared to traditional farmer practices. The data presented in Table 3 indicated that the yield from the IPM module was 3050 and 3020 kg/ha, averaging 3035 kg/ha, while the farmer practice yielded 2611 and 2670 kg/ha, with an average of 2641 kg/ha during the *rabi* seasons of 2022-23 and 2023-24, respectively.

The economic analysis demonstrated that the groundnut crop under the IPM module achieved higher returns, amounting to 179,950 and 184,220 Rs/ha, with an average of 182,085 Rs/ha, in contrast to the farmer practice, which recorded returns of 154,073 and 166,875 Rs/ha, averaging 160,474 Rs/ha during the same periods. The B:C ratio for the IPM module was significantly higher at 2.92 and 3.15 compared to the farmer practice, which had ratios of 2.18 and 2.47 during the rabi seasons of 2022-23 and 2023-24, respectively. The IPM module exhibited favorable outcomes regarding both yield and economic viability for groundnut cultivation. The findings clearly indicated that the B:C ratio for the groundnut crop in the IPM module surpassed that of the farmer practice across all evaluated years. The lack of adoption of the IPM module for managing the sucking pest complex and defoliators in groundnut crops contributed to the lower B:C ratio observed in farmer practices. Consequently, the promising B:C ratio and enhanced net returns associated with the IPM module underscored the economic sustainability of the demonstrated technology, thereby influencing farmers regarding the practical application of the technology in real farming scenarios. The results of this study align with the findings of Kumbar et al. (2021) and Madhushekar et al. (2022).

Table: 3 –Summary of Economics of Integrated Pest Management module in groundnut during *rabi*, 2022-23 and 2023-24

Year	Yield (kg ha^{-1})		Cost of Cultivation (Rs. ha^{-1})		Gross Income (Rs. ha^{-1})		Net Income (Rs. ha^{-1})		B:C Ratio	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2022-23	3050	2611	61670	70794	179950	154073	118280	83279	2.92	2.18
2023-24	3020	2670	58550	67649	184220	166875	125670	99226	3.15	2.47
Average	**3035**	**2641**	**60110**	**69222**	**182085**	**160474**	**121975**	**91253**	**3.04**	**2.33**

Conclusion:

The findings of the study indicate that Groundnut cultivated using Integrated Pest and Disease Management (IPDM) practices yields significantly more than those grown under traditional farming methods. The IPM framework, encompassing all stages from tillage to harvest, has been shown to enhance yield, improve input use efficiency, and provide greater economic advantages. Therefore, it can be inferred that, given the current conditions, the implementation of IPM practices in Groundnut farming could result in superior economic returns compared to conventional methods. This evidence should encourage a greater number of farmers in the Mancherial district of Telangana to adopt IPM practices for Groundnut cultivation.

References:

1. Ahir, K.C., Saini, A and Rana, B.S. (2018). Estimation of yield losses due to major insect pests of groundnut (Arachis hypogaea L.). Journal of Entomology and Zoology Studies. 6(2): 312-314.
2. Amuthaselvi, G., Anand, G., Vijayalakshmi, R., Kanif, A.K., Noorjahan, Dhanushkodi, V., Gayathri, M., Ravi, M. (2023). Yield gap analysis through cluster front line demonstration in blackgram at Tiruchirapalli District. Legume Research. 46: 898-901. doi: 10.18805/LR-5119.
3. Atwal, A.S and Dhaliwal, G.S. (2008). Agricultural Pests of South Asia and their Management. pp. 242.
4. Dabhade, P.L., Bapodra, J.G., Jethava, D.M., Rathod, R.T and Dabhi, M.V. (2012).Estimation of yield losses due to major insect-pests of groundnut in Gujarat.

Legume Research: An International Journal. 35(4):354-356

5. Groundnut Outlook. (2023). Prof. Jayashankar Telangana State Agriculture University. Hyderabad.
6. Harish,G.,Nataraja,M.V.,Jasrotia,P.,Holajjer,P.,Savaliya,S.D andGajera,M*etal*. (2015). Impactofweatherontheoccurrencepattern of insect pests on groundnut. Legume Research: An International Journal. 38(4):524-535.
7. Kandakoor, S.B., Khan, H.K., Gowda, G.B., Chakravarthy, A.K., Kumar,C.A.,Venkataravana,P*etal*. (2012). Theincidenceand abundance of sucking insect pests on groundnut. Current Biotica. 6(3):342-348.
8. Kumbar, P.C., Patil, R.H., Kubsad, V.S and Rudra, N. (2021). Yield gap analysis of major crops grown in northern transition zone of Karnataka. Journal of Farm Sciences. 33(4): 464-469.
9. Madhushekar, B.R., Narendar, G., Goverdhan, M., Kumar, K.A. (2022). Impact of front-line demonstration in transfer of groundnut production technologies for the livelihood improvement of oilseed farmers. International Journal of Bio-resource and Stress Management. 13: 806-814. doi:10.23910/1.202 2.3137.
10. Ramadevi, A., Kumar, Y.P., Charan, G.S., Raghuveer, M., Kumar, M.S., Poshadri, A., Reddy, R.U. (2020). Impact of extension activities on pink bollworm management in Bt-cotton in tribal areas of Adilabad district. Journal of Entomology and Zoology Studies. 8:1683-1687. doi:10.2390/5.2022/3137.
11. Roshan, D.R., Raju, S.V.S., Singh, K.N. (2016). Relative efficacy of acetamiprid+ fipronil combination formulation against BPH (*Nilaparvatalugens*) and GLH (*Nephotettixvirscens*) inrice. Journal of Pure and Applied Microbiology. 10(4):2773-2783
12. Seetharamu, P., Swathi, K., Dhurua, S., Suresh, M., Govindarao, S., Sreesandhya, N. (2020). Bio efficacy of chemical insecticides against major sucking insect pests on grain legumes in India- A review. Legume Research. 43: 1-7. doi: 117.238.240.50.
13. Yadav, G.L., Rajput S.S., Gothwal, D.K., Jakhar, M.L. (2023). Genetic variability, character association and path analysis for pod yield and its component characters in groundnut (Arachis hypogaea (L.)). Legume Research. 46: 678-683. doi: 10.18805/LR-469.