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Research Article

SURVEILLANCE OF INSECT-PEST:AN EFFECTIVE PLANT PROTECTION APPROACH FOR INCREASING PRODUCTIVITY AND PROFITABILITY OF GROUNDNUT (*ARACHIS HYPOGAEA* L.) IN RAIGARH DISTRICT OF CHHATTISGARH

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Abstract- The study was carried out the identify major insect-pest in different crop stages and evaluating the performance of improved cultivars with scientific package and practices on production and productivity of groundnut (*Arachis hypogaea* L.). Cluster frontline demonstrations (CFLDs) were conducted during *kharif* 2018 with K-6 (kadri-6) variety of groundnut. It was observed that 11 species of insect- pests were found to infest the different growth stages of groundnut crop. Most of the major and minor pests infested during the vegetative to pre-maturity stages (45-95 DAS) and the maximum infestation occurred during pod formation and pod filling stages (50-80 DAS) of the crop. The average yield of groundnut under recommended practices were 18.05 q ha^{-1} as compare to 15.28 q ha^{-1} recorded in farmer's practice, average yield increase of 18.13 per cent and additional return of 14240.03 Rs ha^{-1}, respectively. The results revealed that the benefit cost ratio (B:C) of recommended practice (CFLDs) were 1.46 as compared to 1.22 in farmers practice. The extension gap 2.77 q ha^{-1} and technology gap 1.95 q ha^{-1} was recorded. Therefore, the results clearly indicates that the use of improved varieties and package and practices with scientific intervention under frontline demonstration programme contribute to increase the productivity and profitability of oilseeds in Chhattisgarh state.

Keywords- *Cluster frontline demonstrations, Improved variety, Insect- pest of groundnut*

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Introduction

Groundnut (*Arachis hypogaea* L.) is the sixth most important oilseed crop in world. The vegetable oil in rich in omega-3 fatty acid and extensively used for cooking purpose. In addition to providing high quality edible oil (48-50%), easily digestible protein (26-28%), and nearly half of the 13 essential vitamins and 7 of the 20 essential minerals necessary for normal humane growth and maintenance, it produces high quality fodder for livestock. Globally, the crop is raised on 26.4 million hectares with a total production of 37.1 million tonnes. The average productivity is 1400 kg ha^{-1}. India shares 22 per cent of the world production (area 4.9 million hectare, production 5.8 million tonnes). The major growing states are Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Karnataka, and Maharashtra [1]. These constituting and contributing around 80% of area and production. The total area under groundnut is about 8 million hectares and annual production is over 9 million tonnes of pods. Groundnut plays a significant role in the livelihoods of smallholder farmers of rain fed area. In India groundnut is cultivated during *kharif*, rabi and summer season under various cropping systems. The national average production of *rabi* groundnut is higher (1600 kg ha^{-1}) than *kharif* (1000 kg ha^{-1}). In Chhattisgarh groundnut covers an area around 29397 hectare with the production of 40504 m t, among the all district of Chhattisgarh district, Raigarh district is higher in both area and production which covers an area 7572 hectare and production 9930 m t. Rain fed groundnut cultivation coupled with attack by a variety of insect pests and diseases are the major reason for lower productivity. As the crop and its pests are the major reason sensitive to extreme weather events, the crop productivity is determined by the interplay of weather and pests in a given season. Studies reveal that 15 - 20 percent of the total oilseed production is lost directly or indirectly by the attack of insect and mite pests every year [2]. A thorough understanding of these aspects of pest management can help in forecasting any outbreak of the pests and to develop an integrated pest management in groundnut [3]. Therefore, the present study was undertaken to determine the insect pest complex of groundnut, status of the pests, the nature of damages, and the time of appearance of the pests in relation to the phenology of the crop. However, productivity is low due to lack of awareness in farming community regarding improved package and practices of pulse crops. Frontline demonstrations are important dissemination process for transfer of technology and to establish its production potentials on the farmer's fields. It is therefore, necessary to assess the technological gap in production and also to know the problems and constraints in adopting modern groundnut production technologies. Availability of quality seed of improved varieties and other inputs is one of the major constraints in increasing the production of oilseed grains. Keeping this in view, the present investigation was undertaken to study the awareness level of farmer's regarding groundnut cultivation, extent of adoption of improved practices, to find out the yield gap in groundnut production technology. Krishi Vigyan Kendra as resource centre of Agriculture technologies meant for technology application through assessment, refinements and dissemination of proven technologies under different micro farming situation in the district [4]. Keeping this in view, cluster frontline demonstrations were conducted on groundnut (Kadri- 6) during *kharif* 2018 with disseminate the technology in the district to identify major insect-pest in different crop stages, establish production potentials with proven improved technologies on farmer's fields and assessment of adoption and yield gaps and record feedback information from farmer's for further improvement in the research and extension programme.

Material and Methods

The study was carried out in the Raigarh district is located on the Northern part of Chhattisgarh state and lies at 21°54'N latitude and 83°24' E longitude with an

Table-1 *Detail of package and practices for groundnut cultivation*

SN	Technological intervention	Farmer's practice	Recommended practice (CFLD's)
1	Variety	Existing / old recommended cultivar	Kadari-6 (K-6)
2	Seed rate (kgha$^{-1)}$	120	100
3	Seed treatment.	Not practice.	Carbendazime 50 WP @ 3g kg^{-1} seed, Thiamethoxam 25WG 2gkg^{-1} and 5-10 g kg^{-1} seed Rhizobium culture
4	Sowing method/Spacing.	Broadcasting / un uniform plant population	45 x 10 cm, Sowing with seed cum fertilizer drill. Line sown
5	Time of Sowing	15 July -15 August	15July- 30 July
6	Nutrient management.	Imbalance use of fertilizers and 20 kg urea ha^{-1} at and 50 kg DAP at sowing.	Balance fertilization as per soil test values (STV) 82.46 kg Urea ha^{-1}, 468.75 kg SSP ha^{-1} and 40 kg MOP ha^{-1} (Basal Application in line sowing).
7	Weed management.	No weeding/ manually	Imazethapyr 10 SL 40 g ha^{-1} at15-20 DAS
8	Insect, pest and disease management.	No/ injudicious use of and insecticides and fungicides.	Two sprays of Thiamethoxam 25WG @ 0.5 ml l^{-1} of water at 30 and 45 days for sucking pest and one spray of Carbendazim12% + Mencozeb 63% WP @ 40 gm/15 of water for control of tikka disease.

Table-2 *Surveillance of insect- pests under cluster frontline demonstrations in groundnut with their nature of damage and population density per plant.*

Common name	Scientific name	Family	Order	Feeding behavior/ nature of damage	Population/plant or leaf/flower*
Red Hairy caterpillars	*Amsacta albistriga*	Arctiidae	Lepidoptera	Defoliators	0.29-0.31
Bihar hairy caterpillar	*Spilosoma oblique*	Arctiidae	Lepidoptera	Defoliators	2.0-4.0
Groundnut leaf miner	*Stomopteryx subscecivella*	Gelechiidae	Lepidoptera	Leaf miner	0.30-0.34
Tobacco caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera	Defoliators	0.35-0.40
Gram pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera	pod borer and Defoliators	0.12-0.15
Aphids	*Aphis craccivora*	Aphididae	Homoptera	Sap sucker	14.0-17.0
Jassids	*Empoasca kerri*	Jassidae	Homoptera	Sap sucker	6.0-8.0
Thrips	*Haplothrips indicus*	Thripidae	Thysanoptera	Sap sucker	8.0-10.0
Jewel beetle	*Sphenoptera indica*	Buprestidae	Coleoptera	Stem borer	0.08-0.09
Termites	*Odontotermes spp*	Odontotermitidae	Isoptera	Root cutter and eater	20.0-25.0
White grubs	*Holotrichia consanguinea*	Scarabaeidae	Coleoptera	Root cutter and eater	1.0-2.0

**Mean of 10 observations*

Fig-1 *Succession of appearance of important insect- pests of groundnut in relation to crop stages during*

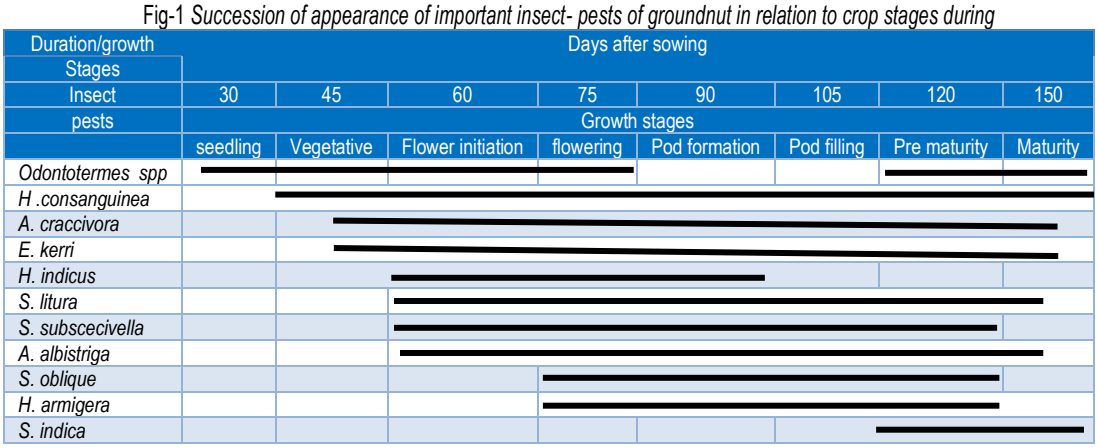

Table-3 *Grain yield and gap analysis of cluster frontline demonstrations on groundnut*

Practice	Average grain yield (q ha^{-1})	% Increase in Recommended Practice (RP)	Extension gap (q ha^{-1})	Technology gap (q ha^{-1})	Technology index
Recommended Practice (RP)	18.05	18.13	2.77	1.95	9.75
Farmer's Practice (FP)	15.28	-	-	-	-

Table-4 *Economic analysis of the cluster frontline demonstrations on groundnut*

Practice	Total returns (Rs ha^{-1})	Input cost (Rs ha^{-1})	Net return (Rs ha^{-1})	Additional return (Rs ha^{-1})	B:C ratio
Recommended Practice RP)	88264.50	60509.82	27754.68	14240.03	1.46
Farmer's Practice (FP)	74719.20	61204.55	13514.65	-	1.22

*Note: MSP of groundnut @Rs.4890.*00 qt-1in 2018-19

altitude of 215 m above the mean sea level (MSL). Cluster frontline demonstrations were conducted in 20 hectares with 49 farmer's during *kharif* 2018 with evaluation the performance of Kadri- 6 variety of groundnut in Ghaghoda block of the district. All the technological intervention was taken as per prescribed package and practices for improved variety of groundnut crop [Table-1]. Observations on the population of different insect pests were recorded from germination to maturity stages (1-100 days after sowing) of the crop. Data on different species of insects were recorded from 10 randomly sampled of the plants in each farmer. Sequential appearance of the insect pests, their nature and quantity of damage and feeding behaviours were carefully observed and recorded at weekly intervals. The insect were graded as major and minor on the basis of their population density per plant, nature and extent of crop damage and yield reduction of the crop. The time of severe attack was noted on the basis of degree of infestation observed in each week. The insect pests were also grouped as root feeders, stem feeders, leaf feeders, leaf roller, sap sucker and borer on the basis of their feeding behaviour. The grain yield, gap analysis, input cost, net return and

additional return parameters were recorded [Table-3] and [Table-4]. Assessment of gaps in adoption of recommended technology before laying out the cluster frontline demonstrations (CFLDs) through personal discussion with selected farmers. The awareness programme (training) was organized for selection of farmer's and skilled development about detailed technological intervention with improved package and practice for successful groundnut cultivation. Scientists visited regularly frontline demonstrations fields and farmer's fields also. The feedback information from the farmer's was also recorded for further improvement in research and extension programmes. The extension activities *i.e*. awareness programme (training), farmer's seminar and field days were organized at the cluster frontline demonstrations sites. The basic information were recorded from the farmer's field's and analyzed to comparative performance of frontline demonstrations (FLD's) and farmer's practice. Different parameters were calculated to find out technology gaps [5].

Extension gap = Demonstrated yield- farmer's practice yield

Technology gap = Potential yield- Demonstration yield

Additional return = Demonstration return – farmer's practice return

$$Technology\ index\ =\ \frac{Potential\ yield\ -\ Demonstration\ yield}{Potential\ yield}\times 100$$

Results and Discussion

The improved package and practices are more important with technological intervention for productivity of oilseed. Detailed package and practices with technological intervention for recommended practice [Table-1]. It was also observed that farmer's use injudicious and un-recommended insecticides and mostly didn't use fungicides [6].

Pest complex and nature of the important pests of groundnut

Eleven species of insect- pests belonging to 9 orders and 5 families were found in groundnut growing fields. During surveillance of insect-pests only five insects identified namely termites (*Odontotermes* spp), aphids (*Aphis craccivora*), thrips (*Haplothrips indicus*), jassids (*Empoasca kerri*) and bihar hairy caterpillar (*Spilosoma oblique*) were considered as the major insect-pests while the rests were of minor importance on the basis of their population densities per plant, nature and extent of damage, and yield reductions. The population density per plant of major and minor insects and their feeding behaviour on groundnut crop is presented in [Table-2]. The population density per plant of major insects, namely *Odontotermes* spp. *A. craccivora, H. indicus, E. kerri* and *S. oblique* ranged from 20.0-25.0, 14.0-17.0, 8.0-10.0, 6.0-8.0 and 2.0-4.0, respectively. The higher insect population may due to the dence forest area, lower relative humidity and rainfall recorded during *kharif* 2018 which provided suitable conditions for the population build-up of the insect- pests. Among the minor insects, white grubs (*Holotrichia consanguinea*), tobacco caterpillar (*Spodoptera litura*), groundnut leaf miner (*Stomopteryx subscecivella*), red Hairy caterpillars (*Amsacta albistriga*), gram pod borer (*Helicoverpa armigera*) and jewel beetle (*Sphenoptera indica*) become occasionally important and cause serious damage to the groundnut crop. On the basis of feeding behaviour, three insects species were grouped as defoliators, three as sap sucker, two as root cutter and eater, one as stem borer another one as leaf miner and remaining one as pod borer. After sowing, termite damages the seeds by boring the underground nuts and cutting the roots and eating the germinating roots and shoots resulting rot of the seeds and plants. The 1st and 2nd instar larvae of *S. obliqua* damaged the groundnut leaves and apex of the shoots and gregariously attack the same plants and leaves. Later on, the 3rd and onward instars dispersed and moved from one plant to another and fed on the older leaves, stems, shoots, and flowers causing serious damage to the plant. *S. litura* is a common cutworm and defoliators. Both the young and full grown larvae feed voraciously on leaves, tender shoots, and flowers. They completely defoliated the plant within a short time. Jassids (*E. kerri*) suck the sap from the leaflets causing yellowing of leaflets, leaf curling, necrosis, and finally stunted the growth and gradually die. It also acts as a vector of a leaf curled, tomato spotted and other viruses. Insects are one of the major constraints in groundnut production and noted that *Aproaerema modicella*, thrips and *Emposca* spp. are having important role in reducing groundnut yield without control measures yield losses of groundnut caused by insect-pest were up to 90 per cent suggested by [7]. The total yield loss due to insect- pests of groundnut was up to 40.2 per cent as observed by [8]. The insect -pests in groundnut have also been recorded by [9,10 and 11]. From different regions of India. 25 species of insect pests attacking groundnut at Ghazipur which were also included in the present record [12].

Succession of the pests

The succession of occurrence of the insect- pests of groundnut with their crop phenology is presented in Fig 1. During the surveillance of insect-pests on groundnut crop was first attacked by termite, *Odontotermes* spp. at seed germination to seedling stage and next attack upto maturity stage. In appearance of white grubs (*Holotrichia consanguinea*), aphid (*Aphis craccivora*), jassid (*Empoasca kerri*) infestation at vegetative and continued up to maturity stage of the crop. While, infestation of thrips (*Haplothrips indicus*) from flowering initiation to pod formation stage. However, tobacco caterpillar (*Spodoptera litura*), groundnut leaf miner (*Stomopteryx subscecivella*) and red hairy caterpillars (*Amsacta albistriga*) infestation were frequently observed from flowering initiation to maturity of the crop. In evidence and infestation of bihar hairy caterpillar (*Spilosoma oblique*) and gram pod borer (*Helicoverpa armigera*) from flowering to maturity and jewel beetle (*Sphenoptera indica*) infestation pre-maturity to maturity of the crop. The succession of appearances of the insect-pests in groundnut showed that the population of different pest species occurred in an overlapping manner and the crop was under the continuous attack of one or more pests. Most of the major and minor pests appeared in the crop during the vegetative and maturity stages and the maximum infestation occurred during flowering initiation, pre maturity and maturity stages of the crop duration. Although most of the insects recorded from groundnut during the study period have been considered as minor, it is not unlikely that any one of the minor insects may attain the status of a major pest depending upon the environmental conditions and changing cropping pattern.

Grain Yield

The grain yield of demonstrated field's and farmer's practice is presented in [Table-3]. Data revealed that average grain yield of demonstrated field's was higher from farmer's practice. The results revealed that average grain yield of groundnut under cluster frontline demonstrations (CFLDs) were 18.05 q ha^{-1} as compare to 15.28 q ha^{-1} recorded in farmer's practice and average yield increase of 18.13 per cent, respectively [13]. The extension gap 2.77 q ha^{-1}, technology gap 1.95 q ha^{-1} and technology index 9.75 was recorded. The above finding was accordance with [14]. This Extension gap should be assigned to adoption of improved dissemination process in recommended practices which outcome in higher grain yield than the farmer's practice. Yield of the recommended practice and potential yield of the crop was compared to estimate the yield gaps which were further categorized in to technology and extension gaps. The observed technology gap may be attributed dissimilarity in soil fertility status, rainfall distribution, disease, insect- pests' infestations and weed intensity well as the change in the locations of frontline demonstration sites. The technology index shows the feasibility of the variety at the farmer's field. The lower value of technology index more is the feasibility of technology. This indicates that a gap existed between technology evolved and technology adoption at farmer's field [15]. Hence, it can be concluded from the [Table-3] that increased yield was due to adoption of improved varieties and conducting demonstration with proven technologies yield potentials of crop can be increased to greater extent. The programme of frontline demonstration could be popularized for other oilseed crops also in order to increase farmer's income and attain self-sufficiency in oilseeds production.

Economics analysis

Economic performance of groundnut under cluster frontline demonstrations were depicted in [Table-4]. The results revealed that the groundnut (Kadari-6) recorded higher total return under recommended practice (CFLD's) were 88264.5.00 Rs ha^{-1} as compared to 74719.2 Rs ha^{-1} farmer's practice. The net returns 27754.68 Rs ha^{-1} in recommended practice in comparison to 13514.65 Rs ha^{-1} in farmer's practice. It was economically observed that additional return 14240.03 Rs ha^{-1} in

recommended practice. The benefit cost ratio also recorded higher in recommended practice with 1.46 as compared to 1.22 in farmer's practice. The higher net returns and B: C ratio in groundnut demonstration might be due to the higher grain yield and better pricing of the produce in the market [15 and 16]. Recommended practice (CFLDs) proved beneficial in respect of yield and economics of groundnut in Raigarh District of Chhattisgarh Plains.

Conclusion

From the above findings, it can be concluded that use of appropriate scientific methods of cultivation under cluster front line demonstration programme on large scale reduced the technological gap to a considerable extent thus leading to increased productivity which increased in the income level of farmer's and improved livelihood of farming community and increased the horizontal spread of the technology to a greater number of farmer's in the district. Thus, resulting in higher grain yield and economic return. The research results accumulated here gives additional information on the insect- pests of groundnut crop. The present information on the status and diversity of the insect- pests of groundnut crops ecosystems in Raigarh district will help formulate the priority research strategies by researchers / academicians.

Application of research: The knowledge on biodiversity in groundnut crops ecosystems will also help the extension workers in deciding the judicious use of insecticides. However, there is need to safer and new chemistry molecules with a distinct class and unique mode of action for sustainable oil seeds production programme.

Research Category: Groundnut crop

Abbreviations:

CFLDs: Cluster Frontline Demonstrations.
DAS: Days After Sowing.

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Study area / Sample Collection: Raigarh district, Chhattisgarh

Cultivar / Variety name: Kadari-6 (K-6)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
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