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Comparative Studies of Lepidopteran Pest Incidence on JL 24 and DH 256 Varieties of Groundnut

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This experiment compares the incidence of lepidopteran pests under protected and unprotected groundnut cultivation at AICRP on Groundnut, MARS, Dharwad, Karnataka in the kharif season of 2021–2022. In order to protect the protected plot from pests, protection measures were

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implemented at 50 DAS using flubendiamide 20 WG @ 0.5g/l for leaf-eating caterpillars. Based on the crop's phenology, observations were made. *Spodoptera litura*, *Thysanoplusia orichalcea*, *Helicoverpa armigera,* and *Maruca vitrata*, were deemed to be the main pests, with the remaining pests being of less significance based on their population density and type of damage. When comparing unprotected JL-24 and DH-256 crop plots to protected plots, the majority of major and minor pests were infested during the vegetative to maturity stage, with maximum infestation occurring during the pod formation and pod filling stages of the crop. In comparison to unprotected plots, protected plots had the highest pod and haulm yields.

Keywords: Groundnut; lepidopteran pests; protected plot; unprotected plot.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a valuable cash crop for millions of small-scale farmers in the semi-arid tropical regions of South America. One of the most significant oil seed crops farmed in India, it provides around 30% of the country's total oil supply. Farmers in India with limited resources primarily cultivate groundnuts as a crop under rainfed systems [1]. India grows groundnuts on an area of around 55.71 lakh hectares during the kharif, rabi, and summer seasons. In 2020–21, the crop produced 102 lakh tonnes and had a productivity of 1831 kg/ha [2]. Abiotic and biotic stresses experienced by the crop during growth are the cause of low groundnut productivity. Diseases and pests are the main biotic stresses on groundnut production. There are more than 100 insects known to feed on groundnuts in India, some of which can be highly harmful and significantly lower yields *viz*., 26 to 100% by *S. litura* and *H. armigera* [3], 25-100% by *A. albistriga* [4]. Among them, red hairy caterpillar *Amsacta albistriga* (Walker), tobacco caterpillar *Spodoptera litura* (Fabricius), gram caterpillar *Helicoverpa armigera* (Hübner), semilooper *Thysanoplusia orichalcea* (Fabricius), leaf miner *Aproaerema modicella* (Deventer) are considered as an important destructive insect pests [5]. 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 [6]. The population of pests and their natural enemies on groundnuts may have shifted recently as a result of varying climatic conditions [7]. Therefore, a thorough understanding of the behaviour of insect pests and their natural enemies on groundnuts will aid in predicting any outbreaks and alerting those who need to be warned. The status and order of pest appearance during the crop period, crop losses and types of damages, and detailed information about a pest complex are all crucial for developing an economically viable, ecologically sound, and socially acceptable pest management strategy [8]. Field research was done in this regard to determine the prevalence of pests on cultivars of groundnuts that are susceptible and moderately resistant varieties.

2. MATERIALS AND METHODS

The experiment was conducted in the field at AICRP on Groundnut, Main Agricultural Research Station, Dharwad, Karnataka during *kharif* season of 2021-22. Field studies were carried out to determine the comparative incidence of major insect pests on two different groundnut cultivars JL-24 (susceptible) and Dh-256 (moderately resistant). Both varieties were sown over a plot size of 10 m x10 m at a spacing of 30 cm x 10 cm. Two separate protected and unprotected JL-24 and Dh-256 plots (10m x 10m) (specify the plot) were maintained throughout the study period. In unprotected plots recommended package of practices was followed to raise the crop except crop protection measures in order to avoid influence of chemicals on insect population. Whereas in protected plots, chemical protection (at 50 DAS with flubendiamide 20 WG @ 0.5g/l for leaf eating caterpillars) was given on a need basis. Observations on different species of insects were recorded from 10 randomly selected plants. Chronological appearance [seedling (10-25 days), vegetative (25-35 days), flower initiation (35-45 days), pegging and pod formation (45-75 days), pod filling (75-90 days), maturity (90-110 days) and harvesting (110-120 days) stage] of the insect pests, their nature and quantity of damage, feeding behaviour and yield reductions were documented. Observations were recorded visually on the standing crop at weekly intervals.

Metarhizium rileyi: *M. rileyi* is the producer of airborne conidia on conidiophores, which are infectious propagules that start the pathogenesis. Conidia stick to the surfaces of their hosts, germinate, and create a germ tube that pierces the host's cuticle, colonizes the insect's

hemocoel, and ultimately kills the insect. The fungus's mycelium was visible on the surface of the larval integument, and as sporulation began, the fungus's white growth changed to an olive-green hue [9].

Sl. NPV: The NPV infection caused the larvae to become inactive, enlarge and become slightly glossy, change the colour of their cuticles to a darker brown, and eventually die. The larvae's lysed cuticle, which becomes frail and secretes a clear liquid that can be either pink or brownish milky white depending on the infection's severity, were the other obvious symptoms. Larva ascending to a higher altitude prior to demise (Tree Top Disease) [10].

3. RESULTS AND DISCUSSION

3.1 Insect Pests and Natural Enemies Observed on Groundnut

Twelve species of insect pests belonging to 3 orders and 9 families of pests were found to infest the groundnut at AICRP on Groundnut, Main Agricultural Research Station, Dharwad during *kharif* season 2021-22. Among these, defoliators *viz*., *Spodoptera litura, Thysanoplusia orichalcea, Helicoverpa armigera*, *Maruca vitrata, Aproaerema modicella* and *Spilarctia obliqua*; Natural enemies like entomopathogens were recorded in both protected and unprotected plot of both the varieties of groundnut.

3.2 Unprotected Plot

3.2.1 Leaf eating caterpillars

In both the varieties larval populations (*S. litura, T. orichalcea, H. armigera, Maruca vitrata* and *A. modicella*) peaked at the time of pegging and pod formation in unprotected plots of JL-24 and Dh-256 (42.25 and 30.00 /10 plants, 23.9 and 18.00/10 plants, 17.43 and 12.31 /10 plants, 19.91 and 17.60 /10 plants and 17.04 and 7.20 /10 plants) (Table 1). Highest larval population of *S. obliqua* was found in the JL-24 plot (between 5.00 and 35.75 /10 plants) as compared with Dh-256 (2.50 to 29.21 /10 plants).

3.2.2 Natural enemies

Metarhizium rileyi and *Spodoptera liture* Nuclear ployhydrosis virus (*Sl.* NPV) *populations* from flowering to pod filling of JL-24 and Dh-256 (5.40 to 42.50 and 2.00 to 24.50;2.04 to 13.20 and 1.00 to 7.00 cadavers/10 plants) (Table 2).

3.3 Protected Plot

3.3.1 Leaf eating caterpillars

In JL-24 and Dh-256 varieties the larval populations of *S. litura* range from 7.95 to 24.68 and 2.15 to 18.50/10 plants from vegetative to maturity stage. Highest population of *T. orichalcea* and *H. armigera* recorded at flower initiation of JL-24 (19.00 and12.05/10 plants) and Dh-256 (15.29 and 9.75/10 plants) (Table 1). Population of *M. vitrata* from vegetative to maturity stage (4.57 to 16.00 and 1.58 and 11.00/10 plants) of both varieties. *A. modicella* vegetative to pod filling stage of JL-24 (1.00 to 8.80/10 plants) and pegging and pod formation in Dh-256 (5.48 and 2.00/10 plants). Highest larval population of *S. obliqua* was recorded during harvesting stage of JL-24 plot (25.50/10 plants) Dh-256 (19.51 /10 plants).

3.3.2 Natural enemies

M. rileyi and *Sl* NPV populations from flowering and pegging and pod formation of JL-24 (10.51 and 6.08;8.91 and 1.89 cadavers/10 plant) and Dh-256 (8.24 and 5.00;4.82 and 0.75 cadavers/10plants) were observed in Table 2.

The above results shows that all the sucking pests and defoliators significantly differed from unprotected plot and protected plots of both the varieties and the highest populations were recorded in JL-24 than Dh-256. This supports the findings of Pal et al., [11] that the Dh- 256 is tolerant to defoliators *viz., S.litura* and leaf miner. JL-24 is susceptible to defoliators and sucking pests with confirmation of research conducted on biochemical and biophysical characters like phenols, wax, trichome density was lower as well as higher sugars in JL-24, which the harbouring of pests of groundnut [12]. In protected plots recorded lowest population because of using insecticides for controlling leaf eating caterpillars *i.e.,* flubendiamide 20 WG @ 0.5g/l. In order to ensure crop yields and reduce post-harvest losses, the use of pesticides, such as insecticides, has evolved from ancient times to become a crucial and strictly necessary agricultural component. Plant protection products are highly toxic to the pests they are intended to control. Utilising them is intended to lessen or get rid of pests totally. Sridhar and Sharma [13] found that, Flubendiamide 20 WG, provided significantly better protection up to 15 days after spraying to soybean crop from the semilooper (1.75 larvae / m row length [mrl]) and *S. litura*

Table 1. Comparative assessment of groundnut varieties JL-24 and Dh-256 for leaf-eating caterpillar incidence

Sl. No	Stage of the crop	*Spodoptera litura*/10 plants				*Thysanoplusia orichalcea*/10 plants				*Helicoverpa armigera*/10 plants			
		JL-24		Dh-256		JL-24		Dh-256		JL-24		Dh-256	
		UP	P	UP	P	UP	P	UP	P	UP	P	UP	P
1	Seedling	-	-	-	-	-	-	-	-	-	-	-	-
2	Vegetative	9.56	9.69	5.96	6.01	10.58	11.61	5.00	5.01	5.00	4.82	2.05	3.00
3	Flower initiation	25.98	24.68	16.98	18.50	18.18	19.00	15.31	15.29	12.00	12.05	9.24	9.75
4	Pegging and pod formation	42.25	13.95	30.00	9.75	23.91	11.24	18.00	9.28	17.43	8.15	12.31	7.40
5	Pod filling	29.86	10.92	18.56	5.66	10.32	5.92	7.01	2.00	9.30	3.21	7.20	2.53
6	Maturity	11.01	7.95	6.01	2.15	3.01	-	1.00	-	2.00	-	1.00	-
7	Harvesting	-	-	-	-	-	-	-	-	-	-	-	-
$T_{(Cal)}$		**2.78**		**2.62**		**2.71**		**2.54**		**2.52**		**2.45**	
$T_{(Tab)}$ @ 0.05		**2.44**		**2.44**		**2.44**		**2.44**		**2.44**		**2.44**	
Sl. No	**Stage of the crop**	***Maruca vitrata*/10 plants**				***Aproaerema modicella*/10 plants**				***Spilarctia obliqua*/10 plants**			
		JL-24		**Dh-256**		**JL-24**		**Dh-256**		**JL-24**		**Dh-256**	
		UP	**P**	**UP**	**P**	**UP**	**P**	**UP**	**P**	**UP**	**P**	**UP**	**P**
1	Seedling	-	-	-	-	-	-	-	-	-	-	-	-
2	Vegetative	-	-	-	-	-	-	-	-	-	-	-	-
3	Flower initiation	15.60	16.00	12.00	11.00	9.00	8.80	5.29	5.48	5.00	5.00	2.50	3.00
4	Pegging and pod formation	19.91	10.50	17.60	7.56	17.04	4.00	7.20	2.00	15.75	9.80	12.50	7.50
5	Pod filling	18.68	8.50	15.67	5.60	16.10	1.00	3.00	-	24.20	12.70	14.65	9.65
6	Maturity	12.57	4.57	8.10	1.58	2.00	-	-	-	30.50	19.50	24.00	15.62
7	Harvesting	-	-	-	-	-	-	-	-	35.75	25.50	29.21	19.51
$T_{(Cal)}$		**2.73**		**2.64**		**3.32**		**2.48**		**2.85**		**2.67**	
$T_{(Tab)}$ @ 0.05		**2.44**		**2.44**		**2.44**		**2.44**		**2.44**		**2.44**	

UP: Unprotected; P: Protected

Table 2. Comparative incidence of natural enemies of insect pests on groundnut var. JL-24 and Dh-256

Sl. No.	Stage of the crop	*Metarhizium rileyi* (Cadavers/10 plants)				*Spodoptera liture* Nuclear ploy hydrosis virus (*Sl.* NPV) (Infected larvae /10 plants)			
		JL-24		Dh-256		JL-24		Dh-256	
		UP	P	UP	P	UP	P	UP	P
1	Seedling	-	-	-	-	-	-	-	-
2	Vegetative	-	-	-	-	-	-	-	-
3	Flower initiation	21.00	10.51	15.50	8.24	10.40	8.91	7.00	4.82
4	Pegging and pod formation	42.50	6.08	24.50	5.00	13.20	1.89	9.23	0.75
5	Pod filling	5.04	-	2.00	-	2.04	-	1.00	-
6	Maturity	-	-	-	-	-	-	-	-
7	Harvesting	-	-	-	-	-	-	-	-
$T_{(Cal)}$		**1.58**		**2.01**		**1.71**		**1.63**	
$T_{(Tab)}$ @ 0.05		**2.44**		**2.44**		**2.44**		**2.44**	

UP: Unprotected; P: Protected

(0.58 larvae / mrl) than untreated check (39.17 and 4.58 larvae / mrl). Tatagar et al. [14] who reported that Flubendiamide 20 WG @ 60 g a.i. /ha was most effective in chilli against *S. litura* and *H. armigera* resulting in highest yield with lowest fruit damage. Sapekar et al. [15], noticed flubendiamide 39.35% SC @ 3 ml superior insecticide which gives maximum protection against semilooper (1.22 larvae / mrl), *S. litura* (2.53 larvae/mrl), *H. armigera* and bihar hairy caterpillar (0.81 larvae / mrl) as compared with untreated check (4.73, 2.40, 4.42 and 4.36 larvae/mrl).

Unprotected plots documented highest number of natural enemies. The present findings were corroborated by Manu, [16], who observed *M. rileyi* in vegetative stage (1.91 cadaver/mrl) and highest was reported at 70 DAS (17.50 cadaver /mrl). The occurrence of the illness coincides with the peak pest activity of the crop; *M. rileyi* infected *S. litura* was seen from 35 DAS and peaked at 65-70 DAS with 33.70%; insecticides were found to be extremely damaging to *M. rileyi* growth [17,18,19].

4. CONCLUSION

The pest incidence varied over the course of the crop phenological stages. The abundance of pests varied between the varieties in addition to the protected and unprotected plots. B Dh-256 tolerance to the main groundnut pests and hence it helps in limiting the use of particular insecticides for the targeted pest. Which in turn results in improved management and lower protection costs for farmers, who can then ensure higher yields and higher profits.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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