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POPULATION DYNAMICS OF MAJOR INSECT PESTS OF LINSEED (*LINUM USITATISIMUM* LINN.) AND ASSESSMENT OF SEED YIELD LOSSES CAUSED BY THEM

Adbhut Yadav*, Tarun Yadav[1] and Rahul Kumar[2]

Department of Entomology, C.C.S. (P.G.) College, Heonra, Etawah (Uttar Pradesh), India.
[1]Department of Zoology, C.C.S. (P.G.) College, Heonra, Etawah (Uttar Pradesh), India.
[2]Department of Horticulture, C.C.S. (P.G.) College, Heonra, Etawah (Uttar Pradesh), India.

Abstract

The maximum incidence of leaf miner was recorded in 3rd standard week of February under both protected and non-protected treatments during both years. However, protected treatment resulted significantly lower incidence of leaf miner as compared to non-protected treatment at all stages during both years. Variety 'ND:-2002' in 2005-06 and 'Garima' in 2006-07 recorded the lowest incidence of leaf miner, however, maximum incidence was recorded with variety 'Neelum' during both years. A period from 3rd standard week to 9th standard week was found to be the most favourable period for higher incidence of linseed budfly under both protected and non-protected treatment during both years. Variety 'Garima' recorded the minimum incidence of budfly during both years. However, maximum incidence of budfly was recorded in variety 'Neelum' during both years. The incidence of semilooper was started from 4th standard week and reached to a maximum level in 8th standard week (0.444 and 0.478) in protected and (1.111 and 1.011) in non-protected treatment in respective years. The incidence of gram pod borer started from 6th standard week and reached maximum at 9th standard week during both years. Protected treatment resulted in significantly the lowest incidence of gram pod borer as compared to non-protected treatment during both years. Protection of insect-pests infestation by Endosulphan 35EC @ 0.07% was found effective under different genotypes of linssed. The per cent increase in grain yield by protected treatment was 24.18 in 2005-06 and 27.86 in 2006-07 as compared to non-protected treatment. The variety 'Neelum' resulted in maximum grain yield of 18.70q/ha followed by 'NDL 2003-4 (18.60q/ha), 'NDL 2002 (18.30q/ha), 'Garima' (14.10q/ha), 'Janki' (13.20q/ha) and 'Padmini' (9.30q/ha) under protected treatment, and variety 'NDL 2003-4' (12.90q/ha) followed by 'NDL 2002' (11.60q/ha) 'Garima' (11.50q/ha), 'Janki' (11.50q/ha), 'Neelum' (11.30q/ha) and 'Padmini' (8.70q/ha) under non-protected treatment. On the basis of mean of protected and non-protected treatment, the varieties followed the order as 'NDL-2003-4' > 'NDL 2002' > 'Neelum' > 'Garima' > 'Janki' and 'Padmini'.

Key words : Population dynamics, linseed bud fly, semilooper, gram pod borer, leaf miner.

Introduction

Linseed (*Linum usitatisimum*) is one of the oldest oilseed crop known as poor man's crop in India. It has got special importance amongst the oil seed crop in *Rabi* season. it is cultivated mainly for oil every part of the linseed is utilized commercially either directly or after processing. The total area and productivity under linseed in world are 3.419 million hectares and 858 kg ha^{-1}, respectively, while in India these are 525.5 thousand hectares and 403 kg ha^{-1}, respectively (Anonymous, 2005). In Uttar Pradesh, the area under linseed cultivation was about 0.81 lakh hectares and production was about 3.96 lakh tonnes with highest productivity level of 456 kg ha^{-1} (Anonymous, 2004). Linseed crop is infested and damaged by number of insect pests (Rai, 1976 and Adbhut *et al*., 2010). Among these insect pests, linseed bud fly (*Dasyneura lini*), semilooper (*Plusia orichacea*), leaf miner (*Phytomyza horticola*) and gram pod borer (*Helicoverpa armigera*) has been rated the most common pests and the peak infestation occurs between mid February and the beginning of March (Adbhut *et al*., 2010 and Kumar *et al*., 2008). Thus, the present study was carried out to know the population dynamics of insect pests of linseed.

*Part of M.Sc. Thesis of first author submitted to N.D. Uni. of Agri. & Tech., Kumarganj, Faizabad - 224229 (U.P.), India.
E-mail: adbhut1985@gmail.com

Materials and Methods

The present study was carried out during *Rabi* season of the year 2005-06 and 2006-07, at the student's Instructional Farm, of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.), India. A good crop of different linseed genotypes Neelam, Garima, Janki, Padmini, NDL-2003-4 and NDL-2002 were maintained by sowing in the month of November 2005 and 2006 and following all the improved agronomic package and practice recommended for the area (except package recommended for insect pest management). The experiment was conducted in Split Plot Design with three replication, each containing main plot (six linseed genotypes Neelam, Garima, Janki, Padmini, NDL-2003-4 and NDL-2002) and subplot (Protected and non-protected) with a plot size was kept 2 × 2.25 m^2 with spacing of 25 cm and 5 cm between line to line and plant to plant, respectively. The incidence of bud fly and leaf miner was observed by counting the number of five tagged plants in each of the replication plot. The observation on infested buds alongwith healthy buds were taken at dough stage. Five plants per plot were selected randomly. Total number of infested as well as healthy buds from these five plants were counted and per cent bud infestation was determined by using the following formula:

$$\text{Bud infestation (\%)} = \frac{\text{No. of infested buds}}{\text{Total no. of buds}} \times 100$$

The number of semilooper (*Plusia orichalcea*) and gram pod borer (*Helicoverpa armigera*) was counted from the top, middle and lower three leaves of the tagged plants. The population counts on each of the tagged plants in each plot were recorded from germination to harvest stage at weekly interval, then the average number of insect was taken on a single plant in each of the replication.

The replication wise yield of linseed was recorded from all the treatments. The yield per plot was converted into yield per hectare. Avoidable losses were calculated by putting the yield in following formula.

$$\text{Avoidable losses \%} = \frac{\text{Yield of protected plot} - \text{Yield of unprotected plot}}{\text{Yield of protected plot}} \times 100$$

Results and Discussion

Leaf miner (*Phytomyza* spp.)

The data on per cent infestation of leaf miner recorded on weekly interval, were affected significantly due to protected and unprotected treatments upto 13th standard weeks during both years except last week of December 1 and 2nd standard week of January during 2006-07. The first appearance of leaf miner was recorded in first week of January during both the years. The per cent incidence of leaf miner was significantly minimum in protected treatment as compared to unprotected treatment at each stage of crop growth and reached maximum upto 8th week in both protected and unprotected treatments and declined thereafter during both the years. It is inferred that the maximum per cent incidence of leaf miner was recorded in 8th standard week of February in both protected and unprotected treatments during both years. The per cent incidence of leaf miner was not affected significantly due to different genotypes at each stage crop growth during both years except 2nd standard week of January 2007. Initially, genotype 'Garima', 'Janki', 'Padmini', 'NDL 2003-4' and 'NDL 2002' recorded the similar per cent infestation of leaf miner in 2005-06. However, the lowest per cent incidence of leaf miner *i.e.* 0.110 was recorded in variety 'Janki' during 2006-07, and reached to a maximum level in 8th standard week during both years. Hence, the lowest per cent incidence of leaf miner was recorded in genotype 'NDL-2002' in 2005-06 of 'Garima' in 2006-07, while maximum incidence in variety 'Neelum' in both years at 8th standard week. Similar finding with regard to infestation of leaf miner was reported by Kumar *et al*. (2008).

Linseed bud fly (*Dasyneura lini* Barnes)

The data pertaining to per cent incidence of bud fly recorded at different weeks during both years were subjected to statistical analysis and presented in tables 2a and b. The per cent incidence of bud fly was affected significantly due to protected and unprotected treatments during both years at all stage of crop growth except 3rd and 4th standard week in January during 2005-06. The first incidence of bud fly was recorded on 3rd standard week during 2005-06 and 2006-07, and continued till 13th standard week in both protected and unprotected treatment during both years. The maximum per cent incidence of bud fly was recorded in 8th standard week during both years in protected and unprotected treatment. The per cent incidence of bud fly in protected treatment was lowest as compared to unprotected treatment. The minimum and maximum per cent incidence of bud fly in protected treatment from 0.075 to 1.012 (3rd and 9th standard week in 2005-06), and 0.179 to 0.978 (3rd and 9th standard week in 2006-07). However, the maximum per cent incidence in unprotected treatment was recorded i.e. 10.987 and 10.936 on 9th standard week during both years. It is concluded that a period from 3rd standard week to 9th standard week was the most favorable period

for higher incidence of linseed bud fly in both protected and unprotected treatment during both years. The different genotypes showed non-significant difference in per cent incidence of linseed bud fly during both years. However, the lowest per cent incidence was recorded in genotypes 'Garima' followed by 'NDL-2002', 'NDL-2003-4', 'Padmini', 'Janki' and 'Neelum' during 2005-06, while during 2006-07, genotypes 'Garima' followed by 'NDL 2003-4', 'Padmini', 'NDL-2002', 'Janki' and 'Neelum'. The maximum per cent infestation of bud fly was recorded in variety 'Neelum' (6.438 and 6.718) on 9th standard week during 2005-06 and 2006-07, respectively. Hence, variety Garima resulted the minimum per cent incidence of bud fly during both years. The maximum per cent incidence of bud fly found in variety Neelum during both years. Srivastava *et al*. (1994) reported that activity of bud fly was initiated in the middle of January with its peak activity during 3rd standard week of January to 2nd standard week of March.

Semilooper (*Plusia orichalcea*)

It is evident from the data presented in tables 3a and b that per cent incidence of semilooper was affected significantly due to protected and unprotected treatments in all weeks during both years except 4th, 12th and 13th standard week during both years. The per cent incidence of semilooper was appeared in 4th standard week in both years. In general, the lower incidence of semiloopeer was recorded in protected treatment as compared to unprotected. The incidence of semilooper varied from 0.089 to 0.444 per cent in 2005-06, and 0.122 to 0.478 per cent in 2006-07 under protected treatment. The incidence started to increase from 4th standard week and being maximum in 8th standard week and thereafter declined during both years in protected and unprotected treatments. Hence, from 4th standard week to 8th standard week was found to be very conducive time for incidence of semilooper in linseed crop. The per cent incidence of semilooper was not affected significantly due to different genotypes in all standard weeks during both years except 8th standard week during 2006-07. Linseed variety 'Garima' in 2005-06 and 'NDL-2002' in 2006-07 recorded the minimum per cent incidence of semilooper at 8th standard week during both years. The maximum per cent incidence was recorded in variety 'Neelum' during both years. The performance of different genotypes with regard to per cent incidence of semilooper at 8th standard week followed the pattern of Garima > Janki > NDL 2003-4 > Padmini > NDL 2002 > Neelum in 2005-06 and NDL 2002 > Padmini > NDL-2003-4 > Garima > Janki > Neelum > during 2006-07. Hence, the varieties 'Garima' and NDL 2002 were found to be the most promising as they showed the lowest per cent incidence of semilooper. Similar finding with regard to infestation of semilooper was reported by Kumar *et al*. (2007) and Adbhut *et al*. (2010).

Gram pod borer (*Helicoverpa armigera*)

The incidence of gram pod borer was recorded in 6th standard week during both years of experimentation and continued till 13th standard week of the crop during both years. The data so recorded were subjected to statistical analysis and summarized in tables 4a and b. The per cent incidence of gram pod borer was affected significantly due to protected and unprotected treatments at all stages during both years except 7th, 11th, 12th, 13th standard weeks in 2005-06 and 6th, 7th, 11th, 12th, 13th standard weeks in 2006-07, where protected and unprotected treatments were found non-significant. The percent incidence of gram pod borer was lower in protected as compared to unprotected treatment in all standard weeks during both years. The maximum percent incidence of gram pod borer was recorded in 9th standard week of both protected and unprotected treatment during both years and thereafter declined till maturity of the crop. It was inferred from the above results that a period from 6th standard week to 9th standard week was found to be most conducive period for incidence of gram pod borer in linseed during both years. The varieties of linseed were not affected significantly due to percent incidence of gram pod borer; however, the variety 'Janki' showed the minimum incidence of gram pod borer at all stages during both years, while maximum incidence was recorded in variety 'Neelum' during both years. Hence, the variety Janki was found most promising with regard to minimum incidence of gram pod borer. Patnaik (2000) and Kumar (2005) reported that peak activity of gram pod borer was initiated in January to 2nd standard week of March.

Avoidable seed yield losses

The grain yield recorded per plot at harvest was converted into q/ha. The data pertaining to grain yield as affected by protected and non-protected treatments and different genotypes of linseed were tabulated and analysed statistically. The results are summarized in table 5. Protection by Endosulfan 35 Ec @ 0.07% improved the grain yield of linseed significantly over non-protected treatment during both years. The per cent increase in grain yield by protected was 24.18 in 2005-06 and 27.86 in 2006-07 as compared to non-protected treatment. In 2005-06, genotype 'NDL 2002' produced significantly higher yield over the rest of the genotype in both protected and non-protected treatments followed by 'Neelum' and 'NDL 2003-04' in case of protected and 'NDL 2003-4'

Table 1a : Incidence of leaf miner on different linseed genotypes under protected and unprotected during *Rabi* 2005-06.

Treatment / Genotype	Standard week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	Leaf miner infested leaves (%)												
Protected	0.22(1.64)	0.53(1.84)	1.06(2.12)	1.21(2.21)	1.36(2.28)	1.92(2.54)	2.07(2.61)	2.08(2.62)	1.73(2.46)	0.99(2.11)	0.66(1.90)	0.33(1.72)	0.18(1.66)
Unprotected	0.44(1.78)	0.69(1.95)	1.40(2.31)	2.25(2.69)	2.99(2.98)	4.70(3.57)	5.55(3.83)	5.66(3.86)	4.96(3.66)	4.40(3.47)	2.36(2.74)	1.44(2.32)	0.66(1.92)
SEm±	**0.035**	**0.014**	**0.042**	**0.025**	**0.058**	**0.029**	**0.036**	**0.031**	**0.048**	**0.037**	**0.059**	**0.029**	**0.029**
C.D. at (5%)	**0.110**	**0.046**	**0.132**	**0.079**	**0.180**	**0.091**	**0.111**	**0.098**	**0.149**	**0.116**	**0.184**	**0.092**	**0.090**
Neelum	0.77(1.32)	0.99(1.40)	1.99(1.71)	2.32(1.81)	2.88(1.95)	3.77(2.16)	4.44(2.30)	4.33(2.26)	4.10(2.22)	3.12(1.98)	1.88(1.67)	1.38(1.51)	0.77(1.32)
Garima	0.22(1.09)	0.60(1.26)	1.71(1.47)	1.55(1.59)	2.10(1.75)	3.22(2.02)	3.99(2.18)	3.99(2.20)	3.22(2.00)	2.55(1.81)	1.55(1.56)	0.83(1.33)	0.22(1.09)
Janki	0.22(1.09)	0.49(1.22)	1.21(1.48)	1.66(1.61)	2.10(1.74)	3.10(1.98)	3.44(2.06)	3.77(2.14)	3.33(2.00)	2.66(1.86)	1.33(1.48)	0.60(1.25)	0.27(1.22)
Padmini	0.22(1.09)	0.49(1.22)	0.99(1.40)	1.33(1.51)	2.10(1.74)	3.10(1.99)	3.44(2.03)	3.66(2.11)	3.10(1.97)	2.77(1.88)	1.44(1.51)	0.60(1.25)	0.55(1.24)
NDL2003-4	0.33(1.14)	0.60(1.26)	0.88(1.35)	1.99(1.72)	1.77(1.61)	3.55(2.10)	3.88(2.18)	3.99(2.19)	3.32(2.05)	2.44(1.81)	1.55(1.58)	0.83(1.31)	0.27(1.22)
NDL 2002	0.22(1.09)	0.49(1.22)	1.10(1.44)	1.55(1.58)	2.10(1.73)	3.10(1.97)	3.66(2.12)	3.49(2.07)	2.99(1.93)	2.55(1.82)	1.33(1.47)	1.05(1.40)	0.44(1.18)
SEm±	**0.071**	**0.031**	**0.069**	**0.078**	**0.06**	**0.098**	**0.073**	**0.039**	**0.044**	**0.040**	**0.081**	**0.063**	**0.056**
C.D. at (5%)	**N.S.**	**N.S**	**N.S.**	**N.S**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 1b : Infestation of leaf miner on different linseed genotypes under protected and unprotected during *Rabi* 2006-07.

Treatment / Genotype	Standard week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	Leaf miner infested leaves (%)												
Protected	0.25(1.67)	0.71(1.95)	1.55(2.36)	1.25(2.22)	1.44(2.18)	1.73(2.46)	1.96(2.58)	.03(2.59)	1.73(2.46)	1.21(2.22)	0.95(2.07)	0.47(1.80)	0.31(1.71)
Unprotected	0.31(1.71)	0.68(1.93)	1.51(2.36)	2.07(2.61)	2.81(2.81)	4.47(3.50)	5.66(3.86)	5.03(3.68)	4.77(3.59)	4.36(3.46)	2.40(2.76)	1.07(2.13)	0.44(1.78)
SEm±	**0.025**	**0.025**	**0.046**	**0.049**	**0.043**	**0.046**	**0.021**	**0.035**	**0.026**	**0.029**	**0.036**	**0.048**	**0.026**
C.D. at (5%)	**NS**	**NS**	**NS**	**0.152**	**0.135**	**0.144**	**0.065**	**0.110**	**0.082**	**0.091**	**0 .114**	**0.149**	**NS**
Neelum	0.55(1.23)	1.10(1.44)	2.55(1.87)	2.44(1.84)	2.77(1.92)	3.66(2.13)	4.33(2.28)	4.66(2.37)	4.10(2.22)	3.55(2.07)	2.33(1.80)	1.22(1.46)	0.66(1.28)
Garima	0.16(1.07)	0.77(1.32)	1.55(1.59)	1.55(1.58)	2.21(1.77)	3.33(2.05)	3.33(2.02)	3.33(2.01)	3.22(2.02)	2.88(1.92)	1.66(1.61)	0.66(1.28)	0.44(1.19)
Janki	0.11(1.05)	0.38(1.17)	1.33(1.52)	1.44(1.54)	1.88(1.67)	2.66(1.86)	3.33(2.03)	3.44(2.07)	3.10(2.00)	2.66(1.86)	1.33(1.51)	0.55(1.23)	0.27(1.12)
Padmini	0.33(1.15)	0.88(1.36)	1.21(1.48)	1.44(1.55)	1.77(1.63)	3.10(1.97)	3.32(2.05)	3.55(2.07)	3.21(2.01)	2.55(1.84)	1.66(1.61)	0.77(1.31)	0.16(1.07)
NDL2003-4	0.27(1.12)	0.66(1.28)	1.22(1.48)	1.55(1.58)	1.66(1.61)	3.10(1.98)	3.33(2.05)	3.99(2.17)	2.77(1.88)	2.66(1.86)	1.55(1.56)	0.77(1.32)	0.44(1.19)
NDL 2002	0.27(1.12)	0.38(1.17)	1.33(1.51)	1.55(1.58)	1.55(1.56)	2.77(1.91)	3.55(2.10)	3.88(2.17)	3.10(1.96)	2.44(1.80)	1.55(1.58)	0.66(1.28)	0.27(1.12)
SEm±	**0.050**	**0.032**	**0.061**	**0.065**	**0.050**	**0.074**	**0.068**	**0.072**	**0.082**	**0.090**	**0.064**	**0.073**	**0.043**
C.D. at (5%)	**N.S.**	**N.S**	**N.S.**	**N.S**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 2a : Incidence of linseed bud fly on different linseed genotypes under protected and unprotected during *Rabi* 2005-06.

Treatment / Genotype	Standard Week										
	3	4	5	6	7	8	9	10	11	12	13
	Bud fly infested buds (%)										
Protected	0.075(1.55)	0.502(1.86)	0.547(1.86)	0.704(1.95)	0.889(2.06)	0.990(2.11)	1.012(2.12)	0.935(2.08)	0.807(2.01)	0.506(1.83)	0.240(0.24)
Unprotected	0.168(1.61)	0.514(1.84)	0.965(2.10)	1.240(2.24)	2.208(2.68)	4.033(3.36)	10.98(5.19)	6.261(4.03)	3.699(3.24)	2.681(2.68)	0.917(1.07)
SEm±	**0.019**	**0.11**	**0.013**	**0.016**	**0.017**	**0.019**	**0.014**	**0.021**	**0.016**	**0.016**	**0.006**
C.D. at (5%)	**NS**	**NS**	**0.042**	**0.052**	**0.055**	**0.059**	**0.044**	**0.067**	**0.052**	**0.050**	**0.019**
Neelum	0.148(1.06)	0.548(1.24)	0.898(1.37)	1.130(1.45)	1.895(1.67)	2.702(1.87)	6.438(2.51)	4.032(2.13)	2.510(1.82)	1.505(1.56)	0.658(1.27)
Garima	0.100(1.04)	0.610(1.36)	0.722(1.30)	0.778(1.33)	1.538(1.57)	2.543(1.83)	5.733(2.39)	3.378(1.99)	2.310(1.76)	1.273(1.48)	0.557(1.24)
Janki	0.110(1.05)	0.523(1.23)	0.675(1.29)	0.942(1.39)	1.450(1.55)	2.390(1.79)	6.163(2.45)	3.362(2.00)	2.237(1.75)	1.350(1.50)	0.522(1.22)
Padmini	0.127(1.06)	0.443(1.20)	0.703(1.30)	0.895(1.37)	1.470(1.56)	2.505(1.81)	5.898(2.42)	3.728(2.06)	2.042(1.69)	1.360(1.51)	0.601(1.25)
NDL2003-4	0.172(1.07)	0.478(1.21)	0.750(1.31)	0.992(1.40)	1.475(1.56)	2.463(1.81)	5.887(2.42)	3.427(2.00)	2.208(1.73)	1.322(1.49)	0.583(1.25)
NDL 2002	0.072(1.03)	0.447(1.20)	0.787(1.33)	1.097(1.43)	1.462(1.55)	2.467(1.81)	5.875(2.42)	3.660(2.04)	2.210(1.73)	1.300(1.48)	0.549(1.23)
SEm±	**0.033**	**0.024**	**0.031**	**0.023**	**0.025**	**0.034**	**0.016**	**0.051**	**0.028**	**0.018**	**0.014**
C.D. at (5%)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 2b : Incidence of linseed bud fly on different linseed genotypes under protected and unprotected during *Rabi* 2006-07.

Treatment / Genotype	Standard Week										
	3	4	5	6	7	8	9	10	11	12	13
	Bud fly infested buds (%)										
Protected	0.179(1.62)	0.598(1.89)	0.813(2.01)	0.873(12.04)	0.938(2.08)	0.953(2.09)	0.978(2.10)	0.961(0.96)	0.767(1.99)	0.601(1.89)	0.268(1.68)
Unprotected	0.435(1.79)	0.792(2.00)	1.372(2.30)	2.268(2.70)	4.174(3.40)	7.151(4.28)	10.936(5.17)	5.726(3.88)	3.577(3.20)	2.387(2.76)	1.208(2.22)
SEm±	**0.014**	**0.012**	**0.011**	**0.021**	**0.018**	**0.011**	**0.030**	**0.023**	**0.013**	**0.014**	**0.010**
C.D. at (5%)	**0.045**	**0.040**	**0.036**	**0.067**	**0.056**	**0.036**	**0.094**	**0.073**	**0.041**	**0.044**	**0.031**
Neelum	0.373(1.16)	0.822(1.34)	1.265(1.50)	1.90(1.68)	2.867(1.91)	4.335(2.18)	6.718(2.54)	3.648(2.05)	2.390(1.78)	1.700(1.61)	0.912(1.36)
Garima	0.253(1.11)	0.695(1.30)	1.025(1.42)	1.593(1.58)	2.438(1.80)	4.115(2.13)	5.445(2.34)	3.183(1.96)	1.987(1.68)	1.468(1.54)	0.625(1.26)
Janki	0.342(1.55)	0.653(1.28)	1.037(1.42)	1.442(1.54)	2.452(1.79)	4.010(2.11)	6.052(2.43)	3.218(1.98)	2.125(1.71)	1.433(1.53)	0.700(1.29)
Padmini	0.317(1.14)	0.678(1.29)	1.055(1.42)	1.522(1.57)	2.615(1.85)	4.023(2.12)	5.833(2.40)	3.397(2.00)	2.144(1.72)	1.405(1.52)	0.647(1.27)
NDL2003-4	0.290(1.13)	0.660(1.28)	1.042(1.42)	1.467(1.55)	2.490(1.82)	3.868(2.08)	5.773(2.40)	3.300(1.97)	2.128(1.72)	1.480(1.54)	0.680(1.28)
NDL 2002	0.267(1.12)	0.663(1.28)	1.333(1.45)	1.500(1.56)	2.477(1.80)	3.958(2.11)	5.920(2.42)	3.315(1.97)	2.258(1.76)	1.477(1.54)	0.865(1.34)
SEm±	**0.025**	**0.018**	**0.016**	**0.019**	**0.042**	**0.022**	**0.060**	**0.033**	**0.025**	**0.013**	**0.015**
C.D. at (5%)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 3a : Population of gram pod borer on different linseed genotypes under protected and unprotected during *Rabi* 2005-06.

Treatment / Genotype	Standard Week							
	6	7	8	9	10	11	12	13
	Population of gram pod borer (Av. no./plant)							
Protected	0.200(1.63)	0.344(1.73)	0.433(1.79)	0.411(1.77)	0.400(1.77)	0.256(1.67)	0.089(1.56)	0.067(1.54)
Unprotected	0.411(1.78)	0.389(1.76)	0.622(1.90)	0.956(2.09)	0.678(1.93)	0.300(1.70)	0.111(1.57)	0.078(1.55)
SEm±	**0.023**	**0.012**	**0.017**	**0.017**	**0.013**	**0.013**	**0.011**	**0.009**
C.D. at (5%)	**0.073**	**NS**	**0.053**	**0.054**	**0.041**	**NS**	**NS**	**MS**
Neelum	0.433(1.19)	0.467(1.20)	0.633(1.27)	0.833(1.34)	0.733(1.31)	0.333(1.15)	0.167(1.07)	0.133(1.06)
Garima	0.333(1.15)	0.333(1.15)	0.433(1.19)	0.633(1.27)	0.400(1.18)	0.267(1.12)	0.067(1.03)	0.033(1.01)
Janki	0.267(1.12)	0.300(1.13)	0.533(1.23)	0.500(1.22)	0.567(1.24)	0.267(1.12)	0.133(1.06)	0.067(1.03)
Padmini	0.200(1.09)	0.333(1.15)	0.567(1.24)	0.667(1.28)	0.467(1.20)	0.267(1.12)	0.100(1.04)	0.033(1.01)
NDL2003-4	0.267(1.12)	0.333(1.15)	0.400(1.18)	0.733(1.30)	0.467(1.20)	0.300(1.13)	0.100(1.04)	0.100(1.04)
NDL 2002	0.333(1.14)	0.433(1.19)	0.600(1.26)	0.733(1.31)	0.600(1.26)	0.233(1.10)	0.033(1.01)	0.067(1.03)
SEm±	**0.031**	**0.028**	**0.019**	**0.020**	**0.042**	**0.025**	**0.026**	**0.021**
C.D. at (5%)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 3b : Population of gram pod borer on different linseed genotypes under protected and unprotected during *Rabi* 2006-07.

Treatment / Genotype	Standard Week							
	6	7	8	9	10	11	12	13
	Population of gram pod borer (Av. no./plant)							
Protected	0.222(1.65)	0.344(1.73)	0.433(1.79)	0.422(1.78)	0.378(1.75)	0.278(1.69)	0.111(1.58)	0.078(1.55)
Unprotected	0.189(1.63)	0.311(1.71)	0.589(1.88)	0.967(2.10)	0.600(1.89)	0.300(1.70)	0.133(1.59)	0.089(1.56)
SEm±	**0.011**	**0.011**	**0.015**	**0.016**	**0.015**	**0.006**	**0.005**	**0.011**
C.D. at (5%)	**N.S.**	**NS**	**0.049**	**0.052**	**0.047**	**NS**	**NS**	**NS**
Neelum	0.467(1.20)	0.500(1.22)	0.700(1.30)	0.900(1.37)	0.700(1.30)	0.433(1.19)	0.200(1.09)	0.133(1.06)
Garima	0.300(1.13)	0.267(1.12)	0.533(1.23)	0.667(1.28)	0.500(1.22)	0.267(1.12)	0.067(1.03)	0.100(1.04)
Janki	0.067(1.03)	0.333(1.15)	0.433(1.19)	0.600(1.26)	0.400(1.18)	0.267(1.12)	0.133(1.06)	0.067(1.03)
Padmini	0.133(1.06)	0.300(1.13)	0.467(1.20)	0.667(1.28)	0.533(1.23)	0.233(1.11)	0.133(1.06)	0.067(1.03)
NDL2003-4	0.133(1.06)	0.300(1.13)	0.500(1.22)	0.700(1.29)	0.367(1.16)	0.300(1.13)	0.100(1.04)	0.033(1.01)
NDL 2002	0.133(1.06)	0.267(1.12)	0.433(1.19)	0.633(1.27)	0.433(1.19)	0.233(1.10)	0.100(1.04)	0.100(1.04)
SEm±	**0.030**	**0.024**	**0.017**	**0.023**	**0.032**	**0.028**	**0.029**	**0.021**
C.D. at (5%)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 4a: Population of semilooper on different linseed genotypes under protected and unprotected during *Rabi* 2005-06.

Treatment / Genotype	Standard Week									
	4	5	6	7	8	9	10	11	12	13
	Population of semilooper (Av. no./plant)									
Protected	0.089(1.56)	0.200(1.64)	0.278(1.69)	0.411(1.78)	0.444(1.80)	0.333(1.73)	0.133(1.59)	0.089(1.56)	0.056(1.54)	0.022(1.51)
Unprotected	0.111(1.58)	0.478(1.82)	0.822(2.02)	0.989(2.11)	1.111(2.17)	0.817(2.01)	0.411(1.78)	0.222(1.65)	0.111(1.58)	0.056(1.54)
SEm±	**0.011**	**0.018**	**0.017**	**0.012**	**0.013**	**0.018**	**0.015**	**0.009**	**0.012**	**0.008**
C.D. at (5%)	**NS**	**0.056**	**0.055**	**0.039**	**0.041**	**0.055**	**0.048**	**0.030**	**NS**	**NS**
Neelum	0.167(1.07)	0.433(1.19)	0.667(1.28)	0.800(1.33)	0.933(1.38)	0.700(1.29)	0.333(1.15)	0.233(1.10)	0.100(1.04)	0.067(1.03)
Garima	0.100(1.04)	0.267(1.12)	0.467(1.20)	0.533(1.23)	0.633(1.27)	0.467(1.20)	0.200(1.09)	0.067(1.10)	0.067(1.03)	0.000(1.00)
Janki	0.033(1.01)	0.333(1.15)	0.500(1.22)	0.633(1.27)	0.733(1.31)	0.600(1.26)	0.267(1.12)	0.200(1.03)	0.100(1.04)	0.067(1.03)
Padmini	0.100(1.04)	0.300(1.13)	0.533(1.23)	0.767(1.32)	0.800(1.33)	0.417(1.18)	0.300(1.13)	0.100(1.04)	0.100(1.04)	0.000(1.00)
NDL2003-4	0.067(1.03)	0.333(1.15)	0.533(1.23)	0.700(1.30)	0.767(1.32)	0.600(1.26)	0.267(1.12)	0.167(1.07)	0.100(1.04)	0.033(1.01)
NDL 2002	0.133(1.06)	0.367(1.16)	0.600(1.25)	0.767(1.32)	0.800(1.33)	0.667(1.28)	0.267(1.12)	0.167(1.08)	0.033(1.01)	0.067(1.03)
SEm±	**0.032**	**0.019**	**0.022**	**0.031**	**0.031**	**0.030**	**0.021**	**0.022**	**0.021**	**0.013**
C.D. at (5%)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 4b : Population of semilooper on different linseed genotypes under protected and non-protected during *Rabi* 2006-07

Treatment / Genotype	Standard Week									
	4	5	6	7	8	9	10	11	12	13
	Population of semilooper (Av. no./plant)									
Protected	0.122(1.58)	0.156(1.61)	0.278(1.69)	0.344(1.73)	0.478(1.82)	0.322(1.72)	0.167(1.61)	0.122(1.58)	0.078(1.55)	0.044(1.53)
Unprotected	0.133(1.59)	0.478(1.82)	0.689(1.94)	0.856(2.04)	1.011(2.12)	0.822(2.02)	0.389(1.76)	0.178(1.62)	0.100(1.57)	0.067(1.54)
SEm±	**0.015**	**0.019**	**0.018**	**0.013**	**0.015**	**0.012**	**0.015**	**0.011**	**0.012**	**0.011**
C.D. at (5%)	**NS**	**0.060**	**0.056**	**0.042**	**0.049**	**0.038**	**0.049**	**0.036**	**NS**	**NS**
Neelum	0.233(1.10)	0.467(1.20)	0.700(1.29)	0.833(1.34)	0.967(1.39)	0.800(1.33)	0.400(1.18)	0.267(1.12)	0.167(1.08)	0.100(1.04)
Garima	0.100(1.04)	0.233(1.10)	0.433(1.19)	0.600(1.25)	0.733(1.31)	0.600(1.26)	0.267(1.12)	0.100(1.04)	0.067(1.03)	0.033(1.01)
Janki	0.133(1.06)	0.333(1.15)	0.433(1.19)	0.567(1.24)	0.767(1.32)	0.533(1.23)	0.267(1.12)	0.133(1.06)	0.100(1.04)	0.067(1.03)
Padmini	0.100(1.04)	0.333(1.15)	0.433(1.19)	0.500(1.22)	0.667(1.28)	0.500(1.22)	0.267(1.12)	0.133(1.06)	0.100(1.04)	0.067(1.03)
NDL2003-4	0.067(1.03)	0.300(1.13)	0.400(1.17)	0.633(1.27)	0.700(1.29)	0.500(1.22)	0.200(1.09)	0.133(1.06)	0.067(1.03)	0.033(1.01)
NDL 2002	0.133(1.06)	0.233(1.10)	0.500(1.22)	0.467(1.20)	0.633(1.27)	0.500(1.22)	0.267(1.12)	0.133(1.06)	0.033(1.01)	0.033(1.01)
SEm±	**0.024**	**0.017**	**0.029**	**0.021**	**0.015**	**0.021**	**0.019**	**0.019**	**0.017**	**0.018**
C.D. at (5%)	**NS**	**NS**	**NS**	**NS**	**0.049**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 5 : Yield losses caused by insect-pests on different linseed genotype under protected and non-protected during *Rabi* 2005-06 and 2006-07.

Genotypes	Seed yield (q/ha)							
	2005-2006				2006-2007			
	Protected	Non-protected	Mean	% yield increase	Protected	Non-protected	Mean	% yield increase
Neelum	18.40	11.20	14.80	39.13	18.70	10.50	14.6	43.85
Garima	14.60	12.30	13.45	15.75	14.10	11.50	12.8	18.43
Janki	14.20	12.60	13.40	11.27	13.20	11.30	12.25	14.39
Padmini	8.70	7.90	8.30	9.19	9.30	8.70	9.00	6.45
NDL-2003-4	17.40	12.70	15.05	27.01	18.60	12.90	15.75	30.64
NDL-2002	18.50	12.90	15.70	30.27	18.30	11.60	14.95	36.61
Mean	**15.3**	**11.6**	**13.45**		**15.36**	**11.08**	**11.08**	**26.45**
SEm ±	**0.22**	**0.42**			**0.22**	**0.43**		
CD at 5%	**0.89**	**1.22**			**0.87**	**1.21**		

and 'Janki' in case of non-protected. However, the trends of different genotypes with regard to mean grain yield of linseed followed the order 'NDL 2002' > 'NDL 2003-04' > 'Neelum' > 'Garima' > 'Janki' > 'Padmini'. The per cent increase in grain yield by protected treatment over non protected treatment was highest (39.13%) in variety 'Neelum' followed by 'NDL 2002', 'NDL 2003-4' and 'Garima'. During 2006-07, variety 'Neelum' resulted the maximum grain yield of 18.70 q/ha followed by 'NDL-2003-4 (18.60 q/ha), NDL 2002 (18.30 q/ha), 'Garima' (14.10 q/ha), 'Janki' (13.20 q/ha) and 'Padmini' (9.30 q/ha) under protected treatment, and genotype 'NDL 2003-4' (12.90 q/ha) followed by 'NDL-2002' (11.60 q/ha), 'Garima' (11.50 q/ha), 'Janki' (11.50 q/ha), 'Neelum' (11.30 q/ha) and 'Padmini' (8.70 q/ha) under non protected treatment. The genotypes followed the order with regard to grain yield were 'NDL 2003-4' > 'NDL 2002' > 'Neelum' > 'Garima' > 'Janki' > 'Padmini'. The highest per cent increase in grain yield by protected over non-protected was recorded with variety 'Neelum' (43.85%) followed by genotype 'NDL 2002' (36.60%) and genotype 'NDL 2003-4' (30.64%). It was concluded from the above results that protection by Endosulfan 35 Ec @ 0.07% was beneficial to control the insects population under different genotypes of linseed for obtaining higher yield. The linseed genotype 'NDL 2003-4' and 'NDL 2002' produced higher grain yield in 2005-06 and 2006-07, respectively. The variety 'Padmini' gave the lowest grain yield during both years.

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