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# IMPACT OF SOWING TIME AND INSECTICIDAL SCHEDULES ON THE INFESTATION OF LINSEED BUD FLY (*Dasyneura lini* Barnes)

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***Abstract:*** *The field experiment was conducted during Rabi seasons of 2012-13, 2013-14 and 2014-15 to assess the relative impact of sowing time and insecticidal schedules on the infestation of linseed bud fly (Dasyneura lini Barnes) at the Linseed Research Farm, College of Agriculture, Nagpur, Maharashtra (India). The experimental results revealed that normal sowing time and insecticidal schedules showed significant differences in reducing bud fly infestation over delayed sowing with no application of plant protection measures. Significantly lower infestation of buds (15.39%) due to D. lini and higher seed yield (832.33 kg/ha) and highest incremental cost benefit ratio (ICBR) of 3.41 was recorded in normal sown linseed crop protected with two fortnightly sprays applied, alternatively starting from bud initiation with Azadirachtin 300 ppm followed by spinosad 45 SC.*
***Key words:*** *Linseed, Dasyneura lini, insecticidal schedules, sowing time.*

**Introduction:** Linseed (*Linum usitatissimum* L) is under cultivation since pre-historic times in the world. Globally, linseed is an important oil seed crop grown for both seed and fibre. In India, it is basically cultivated for oil in *Rabi season*. Currently, its value addition has paved the way for its diversified uses in neutraceutical and medicinal purposes. Linseed bud fly, *Dasyneura lini* Barnes is the most destructive insect pest of linseed. It causes up to 90 per cent reduction[1,2] in seed yield. Chemical insecticides are considered as the most useful in minimizing the bud fly infestation but there is a rising public concern about the potential adverse effects of chemical insecticides on the human health, environment and biodiversity. These adverse effects though, cannot be eliminated completely but their intensity can be minimized through development, dissemination and promotion of alternative technologies such as safer insecticides biopesticides and bioagents as well as good agronomic practices rather than complete reliance hazardous chemical insecticides. The present study was carried out to study impact of sowing time and insecticidal schedules on the infestation of linseed bud fly as an attempt **to** find out economically viable option for sustainable management of linseed bud fly.

**Materials and Methods**

Field experiment was conducted in a factorial randomized block design (FRBD) to study impact of sowing time and insecticidal schedules on the infestation of linseed bud fly during *Rabi* seasons of 2012-13, 2013-14 and 2014-15 at the Linseed Research Farm, College of Agriculture, Nagpur, Maharashtra, India. The plot size was 4.0 m x 2.5 m with spacing of 30 cm and 5 cm between line to line and plant to plant, respectively. The experiment was conducted with eight treatments comprising sowing time and insecticidal schedule combinations. Sowing times (S) were optimum sowing time ($S_1$) and two weeks delayed sowing ($S_2$). And insecticidal schedules (P) were no plant protection ($P_1$), need based application (After reaching ETL *i.e.* 8.77% bud infestation) of insecticide (spinosad 45 SC @ 0.015 %). (0.3 ml/l) ($P_2$), first spray of insecticide (spinosad 45 SC @ 0.015 % (0.3 ml/l)) followed by second application of Azadirachtin 300 ppm (5 ml/l) ($P_3$), and first spray of Azadirachtin 300 ppm (5 ml/l) followed by second spray of insecticide (spinosad 45 SC @ 0.015 %) (0.3 ml/l) ($P_4$). All the treatments were replicated thrice. The crop was sown (variety-Shekhar). The experiment was sown for optimum sowing time in first week of December and later two weeks delayed sowing was done in third week of December during the years of the study. The insecticidal schedules were applied at bud initiation stage with the help of knapsack sprayer and the spray volume was 400 l/ha. The spray was repeated at 15 days interval. For need based application of insecticide schedule, it was applied after crossing the economic threshold level (ETL) of bud fly infestation *i.e.* 8.77%. The insecticides were applied at bud initiation stage with the help of knapsack sprayer and the spray volume was 400 l/ha. The spray was repeated at 15 days interval. The observations of bud fly infestation were recorded at dough stage. The total number of fruiting bodies and number of fruiting bodies damaged due to bud fly only were counted on 10 randomly selected plants at dough stage and per cent damage were calculated. Based on pooled mean value of three years infestation was calculated. Seed yield at harvest was recorded on per plot basis and converted into kg/ha. Based on the pooled results of three years, economics of insecticidal treatments was worked out after year-wise statistical analysis[3] of the data pertaining to bud fly incidence and yield.

## Results and Discussion

Results on the impact of sowing time and insecticidal schedules on the infestation of linseed bud fly are presented in Table 1 by considering the bud fly infestation, seed yield and economic analysis of different treatments is given in Table 2.

**Table 1.: Impact of sowing time and insecticidal schedules on the infestation of bud fly and seed yield of linseed (Pooled results)**

| Treatment combination | No Spray ($P_1$) | Need based application of spinosad ($P_2$) | Spinosad followed by Azadirachtin ($P_3$) | Azadirachtin followed by spinosad ($P_4$) | Mean (S) |
|---|---|---|---|---|---|
| **A) Bud fly infestation (%)** | | | | | |
| **i. Sowing time (S): 2** | | | | | |
| Normal sowing ($S_1$) | 38.22 (38.16) | 23.26 (28.78) | 21.92 (27.89) | 21.61 (27.64) | 26.25 (30.62) |
| Delayed sowing ($S_2$) | 46.45 (42.92) | 37.30 (37.62) | 36.53 (37.17) | 35.31 (36.43) | 38.90 (38.54) |
| **ii. Insecticidal schedules (P) Mean** | **42.34** (40.54) | **30.28** (33.20) | **29.22** (32.53) | **28.46** (32.04) | |
| | | | **Sowing time (S)** | **Insecticidal schedules (P)** | **S x P** |
| | | **S.E. (m) ±** | 0.69 | 0.98 | 1.38 |
| | | **C.D. 5%** | 2.12 | 2.99 | NS |
| **B) Linseed yield (kg ha$^{-1}$)** | | | | | |
| **i. Sowing time (S): 2** | | | | | |
| Normal sowing ($S_1$) | 606.33 | 819.33 | 893.67 | 1010.00 | 832.33 |
| Delayed sowing ($S_2$) | 437.33 | 536.33 | 595.33 | 616.00 | 546.25 |
| **ii. Insecticidal schedules (P) Mean** | 521.83 | 677.83 | 744.50 | 813.00 | |
| | | | **Sowing time (S)** | **Insecticidal schedules (P)** | **S x P** |
| | | **S.E. (m) ±** | 30.84 | 43.62 | 61.68 |
| | | **C.D. 5%** | 94.45 | 133.58 | NS |

*NB: Figures in parentheses are arc sin transformed values*

**Impact on Bud Fly Infestation:** On the basis of the pooled results of the three years, it was found that sowing time (S) and insecticidal schedules (P) recorded statistically significant effect on lowering the bud infestation. Linseed crop sown at normal time ($S_1$) received significantly lower bud infestation of 26.25% in comparison to higher infestation (38.90%) on delayed sown linseed. Insecticide application schedule with first spray of Azadirachtin 300 ppm (5 ml/l) and second spray of insecticide (spinosad 45 SC @ 0.015 %) ($P_4$) had lowest bud infestation (28.46 %) which was at par with insecticide application schedule with first spray of insecticide (spinosad 45 SC @ 0.015 %) and second application of Azadirachtin 300 ppm ($P_3$). Interaction effect of these factors is statistically non significant and recorded lower bud infestation 21.61% in normal sown linseed sprayed with first spray of Azadirachtin 300 ppm and second spray of insecticide (spinosad 45 SC @ 0.015 %) ($S_1xP_4$) (Table 1). The present results get support from the observations of earlier workers that early planted cotton had lower aphids, jassids and red bollworm population than later-planted cotton[4] in Zimbabwe. Lower infestation of stem fly, flea beetle and pod borer was observed early planting (up to 21 August) blackgram than late plantings and significantly resulting in the highest yield[5] in Bangladesh. The effectiveness of azadirachtin 1500 ppm as it recorded highest per cent reduction, 52.83, 51.52 after 7 and 14 days of first spray and 55.40, 53.70 after 7 and 14 days of second spray of bud/capsule damage over control[6] in linseed. Two sprays exhibited least bud infestation in spinosad treated plot found best in reducing bud infestation[7] (7.81 per cent compared to 27.75 per cent in control).

**Table 2.: Economic analysis of sowing time and insecticidal schedules impact on the infestation of bud fly and seed yield of linseed (Pooled results)**

| Sr. No. | Treatments | Bud fly infestation (%) | Seed yield (kg ha$^{-1}$) | Increase in yield over control | | Cost of Protection (Rs ha$^{-1}$) | | | Net monetary Return (Rs ha$^{-1}$) | ICBR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (kg ha$^{-1}$) | (Rs ha$^{-1}$) | Insecticide | Labour charges | Total | | |
| **A.** | **Normal sowing ($S_1$)** | | | | | | | | | |
| 1 | No Spray | 38.22 | 606.33 | 000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0.00 |
| 2 | Need based application of spinosad | 23.26 | 819.33 | 213 | 10507 | 3373 | 2050 | 5423 | 5084 | 0.94 |
| 3 | Spinosad followed by Azadirachtin | 21.92 | 893.67 | 287 | 14174 | 2462 | 2050 | 4512 | 9662 | 2.14 |
| 4 | Azadirachtin followed by spinosad | 21.61 | 1010.00 | 404 | 19913 | 2462 | 2050 | 4512 | 15401 | 3.41 |
| **B.** | **Delayed sowing ($S_2$)** | | | | | | | | | |
| 5 | No Spray | 46.45 | 437.33 | 000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0.00 |
| 6 | Need based application of spinosad | 37.30 | 536.33 | 099 | 4884 | 3373 | 2050 | 5423 | -0539 | -0.10 |
| 7 | Spinosad followed by Azadirachtin | 36.53 | 595.33 | 158 | 7794 | 2462 | 2050 | 4512 | 3282 | 0.73 |
| 8 | Azadirachtin followed by spinosad | 35.31 | 616.00 | 179 | 8814 | 2462 | 2050 | 4512 | 4302 | 0.95 |

*N.B: **Cost of treatment application (Wages & Rent of spray pump) (Rs spray$^{-1}$ ha$^{-1}$) was 1050/-, Cost of Azadirachtin 500 ppm @ Rs. 225/- per lit; Spinosad 45 SC @, 14056/- per lit & Price of Linseed @ Rs. 4933/- per quintal (average of three years).***

**Impact on Linseed Seed Yield:** A sowing of crop at normal time ($S_1$) proved it significant having higher seed yield (832.33 kg ha$^{-1}$) in comparison to delayed sown ($S_2$) linseed (546 kg ha$^{-1}$). Highest mean seed yield of linseed 813 kg ha$^{-1}$ of was recorded in insecticide application schedule with first spray of Azadirachtin 300 ppm and second spray of insecticide (spinosad 45 SC @ 0.015 %) ($P_4$) which was at par (744.50 kg ha$^{-1}$) having insecticide application schedule with first spray of insecticide (spinosad 45 SC @ 0.015 %) and second application of Azadirachtin 300 ppm ($P_3$). Combined effect of sowing time and insecticide application schedule are statistically non significant and recorded higher seed yield production (1010 kg ha$^{-1}$) when sown at normal time ($S_1$) and protected against bud fly with first spray of Azadirachtin 300 ppm and second spray of insecticide (spinosad 45 SC @ 0.015 %) ($S_1xP_4$) (Table 1). Early planting (up to 21 August) blackgram resulting in the significantly higher yield than late plantings[5] in Bangladesh. Highest seed yield (1176.2 kg ha-1) was obtained with application of nimbicidine 0.5 per cent (azadirachtin 1500 ppm) [8] against bud fly in linseed. Bio-efficacy of newer insecticides against linseed bud fly and reported the significantly higher yield in spinosad[7] treated plots (17.77 q/ha). The findings of the earlier workers supports the results of present investigation.

**Economic Analysis (ICBR):** Economic analysis based on the pooled data revealed that highest incremental cost benefit ratio (ICBR) of 3.41 was recorded in treatment combinations when sown at normal time ($S_1$) and protected against bud fly with first spray of Azadirachtin 300 ppm and second spray of insecticide (spinosad 45 SC @ 0.015 %) ($S_1xP_4$) (Table 2) followed by ICBR of 2.14 when sown at normal time ($S_1$) and protected against bud fly with first spray of spray of insecticide (spinosad 45 SC @ 0.015 %) and second spray of Azadirachtin 300 ppm ($S_1xP_3$). Lowest ICBR of (-) 0.10 was recorded in delayed sown linseed crop ($S_2$) receiving need based application (ETL of 8.77%) of spinosad 45 SC @ 0.015 % ($S_2xP_2$) (Table 2). The present results however, gets partial support from the earlier observations[6] who reported maximum ICBR

(1:7.22) with the application of azadirachtin 1500 ppm against linseed bud fly.

**Conclusion:** On the basis of lower bud fly infestation, higher seed yield and incremental cost benefit ratio (ICBR), linseed crop sown at normal time ($S_1$) and protected against bud fly with first spray of Azadirachtin 300 ppm and second spray of insecticide (spinosad 45 SC @ 0.015 %) was found effective.

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