



EFFICACY OF INSECTICIDES AGAINST PEA WEEVIL *BRUCHUS PISORUM* (L.) ON FIELD PEA

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ABSTRACT

Field pea *Pisum sativum* L. is an important legume crop in Ethiopia and insect pests are the major constraints in its production. Amongst these pea weevil *Bruchus pisorum* L. is important. This study evaluates the effects of lambda cyhalothrin (Karate 50EC), chlorantraniliprole (Coragen 200SC) and carbaryl (Sevin 85WP) under field conditions at the Holetta Agricultural Research Center, Ethiopia. The insecticides were applied at flowering, pod setting and both at flowering and pod setting stages, using the susceptible variety 'Burkitu' in randomized complete block design. The results revealed that there was no significant difference among the treatments. Similarly, insecticide application frequency and crop phenology had no effect on the incidence of egg and larvae in field, and on adult emergence under storage conditions.

Key words: *Pisum sativum*, *Bruchus pisorum*, lambda cyhalothrin (Karate 50EC), chlorantraniliprole (Coragen 200SC) and carbaryl (Sevin 85WP), crop phenology, flowering, pod setting, egg, larva, adult

Field pea *Pisum sativum* is the second most important legume crop in Ethiopia after faba bean (CSA, 2018), and it is grown in altitudes ranging from 1800-3000 masl, with annual rainfall of 700-1000 mm (Mussa et al., 2003). However, the productivity remains below world average (2 t/ha) (FAOSTAT, 2017). This might be attributed to biotic and abiotic constraints. Insects such as pea weevil, pea leaf weevil, pea aphid, army worm, Lygus bugs and cut worms are the major pests (Hagedorn, 1976; Gorfu and Beshir, 1994; Daniel, 2010). Bruchids are the most important insect pests of food legumes (Bushara, 1988; Kashiwaba et al., 2003).

Pea weevil *Bruchus pisorum* L., is an economically important pest causing significant losses (Clement et al., 2000). Worku (1998) and Seyoum et al. (2012) also reported yield losses up to 85% and weight losses up to 59% at Sekota, Ethiopia. The seed damage caused by the pest resulted in low market value due to less value for human consumption and animal feed, and also poor in germination (Clement et al., 2002; Seyoum et al., 2012). Thus, it is a cosmopolitan and most destructive insect pest of the pea cultivars which is believed to be introduced in to Ethiopia during mid-1970s (Clement et al., 2009). The insect is strictly monophagous and completes its univoltine life cycle only on pea crop. Upon emergence from hibernation sites, the adults fly into the pea fields and search for mate and oviposition

sites. Many factors decide its preference to oviposit (Mendesil et al., 2016). Female insects first become sexually mature by feeding pea flower (Pajni and Sood, 1975). The larvae once hatched, burrow through the pod wall into maturing seeds to consume them and complete its development resulting in yield and quality loss (Michael et al., 1993). Such cryptic nature complicates its management. Better control of the pest is usually achieved with contact insecticides against adults in fields before they lay eggs on pods (Horne and Bailey, 1991; Smith and Hepworth, 1992; Clement et al., 2000; Afonin et al., 2008). The infestation starts in the field when adults first lay their eggs, which starts from the crop's flowering stage up to pod setting stage. Thus, repeated application of insecticides is required, and generating information on the efficacy of insecticides is required. The present evaluates insecticides viz., lambda cyhalothrin (Karate 50EC), chlorantraniliprole (Coragen 200SC) and carbaryl (Sevin 85WP) and also finds the best time of application of these.

MATERIALS AND METHODS

The experiment was conducted during the main cropping season of 2017/2018 at the Holetta Agricultural Research Center (HARC) field experimental site, Ethiopia (9°00'N, 38°30'E, 2400 masl). Susceptible field pea variety called 'Burkitu' was used with spacing

of 20 and 5 cm between rows and plants, respectively. The insecticides evaluated include- Karate® 50EC (lambda-cyhalothrin) at 0.048 ml; Coragen®200SC (chlorantraniliprole) at 0.03 ml; and Sevin 85WP (carbaryl) at 1.8×10^{-4} kg/ plot. These were applied at flowering, pod setting and both at flowering and pod setting stages, with plots ($1.5 \times 0.8 = 1.2 \text{ m}^2$) arranged in a completely randomized block design and replicated four times. The buffer spacing was 1 and 1.5 m between plots and adjacent replications, respectively. All other agronomic practices were done as recommended for the crop in the area.

Before the second spray at pod setting stage, pods were carefully assessed and estimates of adult *B. pisorum* incidence was made with 25 sweeps with a sweep net following the insect's threshold level (Baker, 2016). Ten plants from each middle row were selected and ten pods with eggs were tagged and the number of eggs from each pod was recorded. After applying the second spray, post-spray egg count was made to see the ovicidal effect. Number of larvae was counted by dissecting 50 dry seeds taken randomly from each tagged pod at harvest. Fifty-gram seeds from each treatment were randomly taken and allocated to determine the number of adults emerged/ experimental unit in a plastic jar of 250 ml capacity. The jars were inspected on daily basis for the emergence of adults. The temperature (°C) and relative humidity (%) of the laboratory room was recorded using thermo-hygrometer on daily basis. The number of days required for adults to emerge was recorded starting from harvest until the first adult emerged off seeds.

The % grain damage was calculated by separating healthy (without holes) ones from the sieved samples following Khattak et al. (1987). After separating grains into damaged with exit holes and undamaged ones, these were weighed separately and % weight loss was computed following Gwinner et al. (1996). Clean, 1000 seeds were taken from each treatment and weighed in gram after adjusting the moisture content to 10% (Cassells and Armstrong, 1998). Yield/ plots at harvest was taken and converted into ha basis. Phytotoxicity score was made after each spray based on leaf scorch scale of 0-3; where 0 = no symptom, 1 = light, 2 = medium, 3 = heavy scorching, according to pesticide efficacy testing protocol and procedures for registration of pesticides in Ethiopia (Lavadinho, 2001; Deneer et al., 2014). Mean of pre and post spray egg counts at pod setting stage was subjected to % efficacy calculation using Abbott's formula (1985).

Germination test was done to observe the effects of the treatments on the pea's seed viability. Fifty seeds were randomly selected from each treatment and placed on moist filter paper on petridish for seven days following Gwinner et al. (1996) and % germination computed. Data on larvae count, adults emerged, % grain damage, grain weight loss and germination were square root transformed and subjected to ANOVA (Gomez and Gomez, 1984) and least significant difference (LSD, $p=0.05$) used for mean separation using SAS v. 9.3 (SAS, 2011) software.

RESULTS AND DISCUSSION

There was insignificant difference with pre and post treatment application egg counts; though statistically non-significant, there was a clear reduction with treatments. Seidenglanz et al. (2011) observed that pyrethroid insecticides were more effective compared to the neonicotinoids. As such the number of died eggs might be compensated by the newly oviposited eggs and, egg numbers before and after treatment application probably balanced each other. Position of eggs on the pods in relation to the direction of spraying and eggs which might be laid after the treatment application could also influence the egg numbers. The form in which the eggs of *B. pisorum* laid might also have its influence on the efficiency of the treatments as the eggs of the insect usually laid in the form of clusters than single eggs in which only the upper top eggs face treatments and the bottom eggs rarely affected by the applied insecticides (Seidenglanz et al., 2007).

With, larval and adult counts also the results are non-significant, but with larvae, carbaryl at flowering stage showing maximum efficacy (Table 1). Aznar-Fernandez et al. (2018) and Afonin et al. (2008) observed that food competition can lead to death of many larvae. As many as 45 eggs can be laid on single pod and usually about 5 larvae can get into one grain even though usually only one larvae develops and pupate while the others perish either because of physical damage during exit or due to food competition. Thus, the larvicidal effects, the number of emerged adults became minimal and there were no significant differences. Thousand seed weight and yield also did not show significant differences, as infestation of *B. pisorum* starts in the field and the feeding continues until the adults exit off the seeds in the store. As such, the effect the insect is more of on seed weight loss and quality in the store than direct yield loss at harvest, the result in line with the findings of Gagic et al. (2016). Only least grain damage and loss in

Table 1. Efficacy of insecticides on *B. pisorum* on field pea

| Treatments | Egg counts (eggs/pod) | | Larvae/ 50 seeds** (Mean± SE) | No. of adults/ 50 g seeds** (Mean± SE) | Grain damage (%) ** | Grain weight loss (%)** | Germination (%)** | Days to adult Emergence | Efficacy of treatments on egg (%) | Thousand seed weight (g) (Mean± SE) | Yield (Qt./ ha) (Mean± SE) |
|---|-------------------------------|------------------------------|-------------------------------------|--|---------------------------|----------------------------|----------------------|----------------------------|---|--|----------------------------------|
| | Before spray (Mean± SE) | After spray (Mean± SE) | | | | | | | | | |
| - Karate® 50EC (lambda-cyhalothrin) (F) | 4.50±0.17 | 2.03±0.1 | 5.5 (2.28± 0.09) | 2.25 (1.54± 0.08) | 0.76 (1.09± 0.03) | 0.1 (0.77± 0.02) | 89 (94.26± 0.64) | 50.63±2.68 | 61.44 | 308.77±2.08 | 41.45±1.74 |
| - Karate® 50EC (lambda-cyhalothrin) (P) | 4.58±0.14 | 2.10±0.09 | 4.25 (1.92± 0.2) | 3 (1.75± 0.17) | 0.85 (1.1± 0.12) | 0.21 (0.83± 0.03) | 91 (95.31± 0.88) | 44.18±2.35 | 50.08 | 291.27±7.81 | 37.18±2.13 |
| - Karate® 50EC (lambda-cyhalothrin) (F+P) | 3.83±0.22 | 1.58±0.13 | 2.25 (1.61± 0.17) | 4 (1.94± 0.09) | 1.83 (1.38± 0.05) | 0.47 (0.95± 0.01) | 88 (93.76± 0.28) | 53.2±2.12 | 53.60 | 298.52±6.40 | 42.63±1.23 |
| Coragen®200SC (chlorantraniliprole) (F) | 4.53±0.14 | 1.85±0.05 | 2.25 (1.61± 0.08) | 1.25 (1.26± 0.18) | 0.47 (0.97± 0.12) | 0.16 (0.81± 0.04) | 85 (92.17± 0.79) | 62.28±0.62 | 66.59 | 296.74±0.86 | 36.05±1.56 |
| Coragen®200SC (chlorantraniliprole) (P) | 3.98±0.16 | 1.65±0.07 | 3.5 (1.88± 0.09) | 1.75 (1.41± 0.11) | 0.45 (0.95± 0.06) | 0.14 (0.8± 0.01) | 90 (94.84± 0.43) | 52.15±2.75 | 52.12 | 268.34±6.19 | 40.6±1.53 |
| Coragen®200SC (chlorantraniliprole) (F+P) | 4.65±0.28 | 2.03±0.16 | 7 (2.61± 0.12) | 3.25 (1.88± 0.07) | 0.99 (1.18± 0.05) | 0.22 (0.84± 0.01) | 84 (91.64± 0.62) | 47.73±1.83 | 56.32 | 278.42±5.42 | 42.96±1.39 |
| Sevin 85WP (carbaryl) (F) | 5±0.13 | 2.30±0.05 | 1.5 (1.35± 0.18) | 4 (1.98± 0.1) | 1.24 (1.27± 0.08) | 0.17 (0.82± 0.01) | 81 (89.99± 0.2) | 40.85±2.03 | 58.22 | 285.74±2.55 | 45.72±1.79 |
| Sevin 85WP (carbaryl) (P) | 4.78±0.21 | 2.23±0.1 | 9.25 (2.98± 0.17) | 2 (1.48± 0.15) | 0.56 (0.95± 0.07) | 0.09 (0.76± 0.02) | 89 (94.3± 0.58) | 62.7±1.26 | 64.01 | 281.67±5.37 | 35.96±0.63 |
| Sevin 85WP (carbaryl) (F+P) | 4.63±0.22 | 2.13±0.09 | 7.5 (2.56± 0.06) | 4.25 (1.96± 0.08) | 1.95 (1.45± 0.04) | 0.34 (0.9±0.01) | 91 (95.31± 0.43) | 55.65±3.14 | 53.33 | 271.5±1.79 | 38.93±0.57 |
| Control (untreated) | 5±0.24 | 2.30±0.09 | 4.75 (2.14± 0.06) | 4 (2.06± 0.08) | 1.18 (1.24± 0.05) | 0.22 (0.85± 0.02) | 85 (92.18± 0.58) | 50.5±2.66 | 0.00 | 295.07±2.14 | 45.41±1.24 |
| LSD (0.05) | 1.22ns | 0.77ns | 1.33ns | 1.07ns | 0.66ns | 0.20ns | 4.75ns | 21.76ns | - | 42.60ns | 9.74ns |
| CV | 18.42 | 26.34 | 43.76 | 42.83 | 39.11 | 17.03 | 3.5 | 28.85 | - | 10.21 | 16.5 |

**=Square root transformed; (F) = at flowering, (P) = at pod setting, (F+P) = at both flowering and pod setting stages; ns = non-significant (p>0.05), SE = standard error. means within parentheses in a column after transformation; ns= non-significant (p>0.05); SE= standard error.

grain weight were observed as the insecticides inhibited only the pupation of larvae with their larvicidal effects. These results agree with those of Smith (1990) that grain weight loss is <4% when the *B. pisorum* is managed by spraying insecticides. This study also conforms to the findings of Horne and Bailey (1991) that damage can be reduced by managing adult *B. pisorum* in the field pea.

Fumigating the stored pea also found to be associated with lower damage (Mihiretu and Wale, 2013). Results from germination test showed non-significant difference, it was >80% in all treatments agreeing with observations of Matthews and Holding (2005). There was non-significant difference with regard to days for adult emergence- the least of 40.85 ± 2.03 was observed in carbaryl applied at flowering stage, and maximum of 62.7 ± 1.26 with carbaryl sprayed at pod setting stage; while chlorantraniliprole at flowering stage and carbaryl at pod setting stage were the best in delaying the number of days to adult emergence. The efficacy of the treatments at three growth stages 50.08 to 66.59% with insignificant differences- chlorantraniliprole at flowering stage showed maximum efficacy (66.59%), followed by carbaryl at pod setting stage (64.01%). Thus, in general carbaryl and chlorantraniliprole at flowering stage performed best with terms of their larvicidal effects.

ACKNOWLEDGEMENTS

The authors thank the Holetta Agricultural Research Center for providing the planting material, experimental plots and some laboratory materials; also, the Ethiopian Institute of Agricultural Research (EIAR) for funding the project.

Conflict of interest: No potential conflict of interest reported.

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(Manuscript Received: September, 2020; Revised: January, 2021;
Accepted: January, 2021; Online Published: August, 2021)
Online published (Preview) in www.entosocindia.org Ref. No. e20357