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# Bio-efficacy of some insecticides against pest complex of blackgram [*Vigna mungo* (L.) Hepper]

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ABSTRACT

An investigation was carried out on bio-efficacy of newer insecticides against pest complex of blackgram [*Vigna mungo* (L.)] at Navsari Agricultural University, Navsari, Gujarat during *Kharif* season. Among the tested eleven insecticide, the higher effectiveness was observed with the application of clothianidin 50 per cent WDG (0.003%) against whitefly, jassid and aphid. While, spinosad 2.5 SC (0.002%) was the most effective against gram pod borer and spotted pod borer.

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## INTRODUCTION

Blackgram also known as *mashkalai* or *Mash* or *Urd* or Mosh belongs to the family leguminosae, sub family paplionodieae. It is believed to be originated in India. In addition, it is widely used as nutritive fodder crop especially for milch animals. The food value of blackgram is mainly due to its high level of protein contents (26.2 %). Besides this, it also contain calorie (350/100g) with vitamins *viz*., $B_1$, $B_2$ and Miyacin (0.42, 0.37 and 2.0 mg/100g). A part from being major source of protein, it is a rich source of minerals *viz*., calcium, iron and phosphorus (185, 8.7 and 345 mg/100g). It also contains 56.6 per cent carbohydrates and 1.2 per cent fat. Being rich in protein and phosphoric acid, it is an important part in our diet (Thakur, 1975). In addition to the nutritive importance, it also enriches the soil fertility by fixing atmospheric nitrogen (42 kg/ha) into the soil. In India, it is grown in state of Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Tripura (Singh and Singh, 1977). However, this pulse has not been given sufficient importance as its acreage and production are not yet to be recorded in the crop census of the country. Although, it is seen that nearly 31 per cent of total pulse acreage and over 21 per cent of total pulse production in India is by *Urd*, *Mung* and *Cowpea* (Sachan *et al*., 1994). Although, all the efforts are being made by the cultivators for high production, even though we have not been able to achieve the higher yield potential of various pulses including blackgram. Among various constraints responsible for miserable low yield of such an important pulse crop, the loss due to insect pests is considered to be important. It is unfortunate fact that every year we loss 15-20 per cent pulses due to ravages of pest complex infesting pulses (Lal and Sachan, 1987). In blackgram, the avoidable loss in yield due to insect pest was recorded to be 34.7 per cent (Saxena, 1983). According to Pandey *et al*.

(1991) yield of blackgram was reduced to about 2.75 quintal/ hectare, which is about 33.51 per cent. In India about 18 species of insect pests damage the blackgram (Singh and Singh, 1977). According to Nayar *et aI*. (1976) the crop is attacked by more than 20 insect pest species. As many as 30 insects of different groups appeared in succession at different stages of crop growth of blackgram (Dhuri and Singh, 1983). Among these, only a few of them are considered to be major pests of blackgram. The important insect pests attacking the crop are as under :

- Jassid *Empoasca kerri* Pruthi
- Thrips *Megalurothrips distalis* Karny, *Caliothrips indicus* Bangal
- Whitefly *Bemisia tabaci* Gennadius
- Aphid *Aphis craccivora* Koch
- Leaf miner *Acrocercops caerulea* Meyrick, *Liriomyza trifolii* Burgess
- Blue butter fly *Euchrysops cnejus* Fabricius
- Gram pod borer *Heliothis armigera* Hubner
- Spotted pod borer *Maruca testulalis* Geyer
- Pink borer *Cydia ptychora* Meyrick
- Galerucid beetel *Madurasia obscurella* Jacoby
- Semilooper *Plusia orichalcea* Fabricius
- Leaf eating caterpillar *Spodoptera litura* Fabricius

Among the various insects pests listed above, jassid, whitefly, aphid, spotted pod borer and gram pod borer are serious pests attacking plant parts like leaves, buds, flowers and pods of blackgram. Among sucking pests, the nymph and adults of aphid suck the sap from ventral surface of tender leaves, growing shoots, flower stalks and pods. The infested leaves turn pale yellow, the shoots wither, flower buds fall off, whereas the pods shrivel and become malformed. The adults and nymphs of jassid cause damage by sucking the cell sap from under side of leaves and inject toxic saliva into the tissues. Whitefly cause heavy economic direct loss of plant vitality due to feeding cell sap. The damage due to pod borer complex was ranged from 8.1 to 22.6 per cent as estimated by Sontakke and Muduli, 1990 in blackgram.

## MATERIAL AND METHODS

Field experiment was carried out to evaluate the efficacy of various insecticides against pest complex of blackgram (variety T-9) at college farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari. The crop was sown at a spacing of 45×15 cm with a net plot size of 1.80×0.60 m. The experiment was laid out in Randomized Block Design with twelve treatments including control (unsprayed) replicated four times. First spray application of newer insecticides was applied on the crop at the appearance of the insect pests using manually operated knapsack sprayer. For recording observation five plants were selected randomly from each treatment plot and tagged. Observations were recorded before one day and after one, two, three and seven days after spraying of different insecticidal treatments. The data thus obtained were statistically analyzed. For judging the overall performance of treatments, the data recorded at one, two, three and seven days were pooled.

## RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads :

**Jassid (*E. kerri*) :**

The population of jassid recorded before spray was found to be non-significant among different treatments, which indicated that the infestation of jassids was in homogenous condition (Table 1). The treatment difference were found significant results on jassid population recorded at one day after spraying indicated that clothianidin recorded the lowest jassid population (1.28) which was at par with acetamiprid, imidacloprid, thiamethoxam, fipronil, thiodicarb and spinosad as they recorded 1.33, 1.43, 1.62, 1.70, 1.85 and 1.93 jassids/ leaf, respectively. Endosulfan, novaluron, emamectin benzoate and monocrotophos recorded 2.00, 2.03, 2.15 and 2.18 jassids/ leaf, respectively. The higher number of jassids was observed in control (2.63).

The data recorded at seven day after spraying (Table 1) indicated that clothianidin recorded lower jassid population (0.12) and it was at par with acetamiprid, imidacloprid, thiamethoxam and fipronil as they recorded 0.17, 0.27, 0.37 and 0.40 jassid/leaf, respectively. Thiodicarb (0.80), spinosad (0.95), emamectin benzoate (1.12), novaluron (1.13), endosulfan (1.17) and monocrotophos (1.53) were in the chronological order of effectiveness.

Pooled data over periods (Table 1) indicated that the lower numbers of jassids were observed in clothianidin (0.45) and were at par with acetamiprid (0.55), imidacloprid (0.62), thiamethoxam (0.71) and fipronil (0.85). Thiodicarb (1.04) and spinosad (1.15) were next effective treatments. The remaining treatments *viz.*, endosulfan, emamectin benzoate, novaluron and monocrotophos recorded 1.28, 1.33, 1.36 and 1.63 jassids/ leaf, respectively. Maximum population of jassid (2.26) was found in control.

Patil (2006) reported that lowest jassid population was recorded in the treatment of clothianidin 0.003 per cent in greengram crop. Thus, the present findings are in agreement with above findings. Srivastava and Singh (1976) reported that *E.kerri* on blackgram could be effectively controlled by spraying endosulfan 0.07 per cent or dimethoate 0.03 per cent @ 700 liters/ha under Uttar Pradesh conditions. Gatoria and Singh (1984) observed that foliar application with monocrotophos 0.04 per cent and dimethoate 0.03 per cent had been found effective against the jassid infesting greengram. Lal (1985) reported that monocrotophos 0.04 per

cent and endosulfan 0.07 per cent at 6th week of sowing gave effective control of jassid on mungbean under Uttar Pradesh condition. Borah (1994) reported that foliar spray of cypermethrin (0.01% and 0.05%), deltamethrin (0.028% and 0.0042%) and dimethoate (0.03% and 0.045%) were the most effective against jassid (*E. kerri*) on greengram.

**Whitefly (*B. tabaci*) :**

The pooled data (Table 2) indicated that treatment clothianidin (0.46) was the most effective treatment and it was

**Table 1 : Effect of different insecticides against *E. kerri* on blackgram**

| Sr. No | Treatments | Dose (%) | Mean no. of E. kerri / leaf | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | BS | 1 DAS | 2 DAS | 3 DAS | 7 DAS | Pooled |
| 1. | Imidacloprid 17.8% SL | 0.005 | 1.91(3.17) | 1.38(1.43) | 1.06(0.65) | 0.79(0.13) | 0.87(0.27) | 1.06(0.62) |
| 2. | Acetamiprid 20% SP | 0.004 | 1.92(3.18) | 1.35(1.33) | 1.05(0.63) | 0.75(0.07) | 0.81(0.17) | 1.02(0.55) |
| 3. | Clothianidin 50 % WDG | 0.003 | 1.87(3.00) | 1.33(1.28) | 0.93(0.40) | 0.72(0.02) | 0.78(0.12) | 0.97(0.45) |
| 4. | Novaluron 10% EC | 0.0075 | 1.82(2.82) | 1.59(2.03) | 1.34(1.33) | 1.20(0.95) | 1.28(1.13) | 1.36(1.36) |
| 5. | Spinosad 2.5% SC | 0.002 | 1.89(3.07) | 1.55(1.93) | 1.21(1.02) | 1.10(0.72) | 1.20(0.95) | 1.28(1.15) |
| 6. | Thiamethoxam 25% WG | 0.005 | 1.92(3.18) | 1.45(1.62) | 1.08(0.70) | 0.81(0.17) | 0.93(0.37) | 1.10(0.71) |
| 7. | Thiodicarb 75% WP | 0.10 | 1.90(3.12) | 1.53(1.85) | 1.19(0.92) | 1.04(0.60) | 1.14(0.80) | 1.23(1.04) |
| 8. | Fipronil 5% SC | 0.005 | 1.81(2.80) | 1.47(1.70) | 1.14(0.83) | 0.97(0.45) | 0.94(0.40) | 1.15(0.85) |
| 9. | Emamectin benzoate 5% WG | 0.002 | 1.91(3.17) | 1.62(2.15) | 1.28(1.18) | 1.15(0.85) | 1.26(1.12) | 1.34(1.33) |
| 10. | Monocrotophos 36% WSC | 0.04 | 1.83(2.85) | 1.63(2.18) | 1.42(1.53) | 1.32(1.25) | 1.42(1.53) | 1.45(1.63) |
| 11. | Endosulfan 35% EC | 0.075 | 1.94(3.28) | 1.58(2.00) | 1.24(1.08) | 1.16(0.85) | 1.29(1.17) | 1.33(1.28) |
| 12. | Control | - | 1.93(3.23) | 1.77(2.63) | 1.62(2.15) | 1.61(1.20) | 1.63(2.17) | 166(2.26) |
| S.E. ± | | | 0.07 | 0.08 | 0.10 | 0.06 | 0.07 | 0.07 |
| C.D. (P = 0.05) | | | NS | 0.24 | 0.30 | 0.17 | 0.19 | 0.19 |
| S.E. ± (P×T) | | | - | - | - | - | - | 0.05 |
| C.D. (P = 0.05) (P×T) | | | - | - | - | - | - | 0.15 |
| C.V. (%) | | | 7.75 | 11.06 | 17.24 | 11.24 | 11.88 | 10.68 |

BS = Before spray; DAS = Days after spray; NS = Non-significant; *Figures in parentheses are retransformed values, those outside parentheses are square root transformed values ($\sqrt{x} + 0.5$)

**Table 2 : Effect of different insecticides against *B. tabaci* on blackgram**

| Sr. No | Treatments | Dose (%) | Mean no. of *B. tabaci* / leaf | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | BS | 1 DAS | 2 DAS | 3 DAS | 7 DAS | Pooled |
| 1. | Imidacloprid 17.8% SL | 0.005 | 1.99(3.48) | 1.32(1.28) | 1.06(0.65) | 0.78(0.12) | 0.87(0.27) | 1.04(0.58) |
| 2. | Acetamiprid 20% SP | 0.004 | 1.88(3.03) | 1.25(1.08) | 1.05(0.62) | 0.77(0.10) | 0.87(0.25) | 1.00(0.51) |
| 3. | Clothianidin 50 % WDG | 0.003 | 1.88(3.05) | 1.24(1.05) | 1.00(0.52) | 0.75(0.07) | 0.85(0.22) | 0.98(0.46) |
| 4. | Novaluron 10% EC | 0.0075 | 1.92(3.20) | 1.49(1.72) | 1.27(1.13) | 1.10(0.73) | 1.00(0.50) | 1.23(1.02) |
| 5. | Spinosad 2.5% SC | 0.002 | 1.86(3.00) | 1.45(1.63) | 1.22(1.00) | 1.08(0.70) | 0.93(0.37) | 1.19(0.93) |
| 6. | Thiamethoxam 25% WG | 0.005 | 1.92(3.18) | 1.34(1.30) | 1.10(0.70) | 0.78(0.12) | 0.88(0.27) | 1.05(0.60) |
| 7. | Thiodicarb 75% WP | 0.10 | 1.87(3.02) | 1.39(1.43) | 1.17(0.88) | 0.94(0.40) | 0.90(0.32) | 1.12(0.76) |
| 8. | Fipronil 5% SC | 0.005 | 1.88(3.07) | 1.36(1.37) | 1.13(0.78) | 0.88(0.28) | 0.95(0.42) | 1.10(0.71) |
| 9. | Emamectin benzoate 5% WG | 0.002 | 1.88(3.00) | 1.53(1.85) | 1.33(1.28) | 1.25(1.07) | 1.00(0.52) | 1.29(1.18) |
| 10. | Monocrotophos 36% WSC | 0.04 | 1.90(3.12) | 1.53(1.87) | 1.32(1.25) | 1.14(0.82) | 1.01(0.53) | 1.27(1.12) |
| 11. | Endosulfan 35% EC | 0.075 | 1.93(3.23) | 1.47(1.68) | 1.21(0.97) | 1.06(0.63) | 0.99(0.48) | 1.20(0.94) |
| 12. | Control | - | 1.88(3.05) | 1.72(2.47) | 1.72(2.45) | 1.68(2.32) | 1.76(2.62) | 1.72(2.46) |
| S.E. ± | | | 0.07 | 0.07 | 0.07 | 0.06 | 0.04 | 0.04 |
| C.D. (P = 0.05) | | | NS | 0.21 | 0.19 | 0.16 | 0.12 | 0.13 |
| S.E. ± (P×T) | | | - | - | - | - | - | 0.05 |
| C.D. (P = 0.05) (P×T) | | | - | - | - | - | - | 0.15 |
| C.V. (%) | | | 7.04 | 10.43 | 11.13 | 11.11 | 8.24 | 7.50 |

BS = Before spray; DAS = Days after spray; NS = Non-significant; *Figures in parentheses are retransformed values, those outside parentheses are square root transformed values ($\sqrt{x} + 0.5$)

at par with acetamiprid (0.51), imidacloprid (0.58), thiamethoxam (0.60) and fipronil (0.71). Remaining treatments *viz.*, thiodicarb (0.76), spinosad (0.93), endosulfan (0.94), novaluron (1.02), monocrotophos (1.12) and emamectin benzoate (1.18) were least effective. The highest whitefly population was recorded in control (2.46). The interaction between period and treatment (P x T) was significant indicating inconsistent performance of treatments over periods.

Afzal *et al*. (2002) reported that imidacloprid 25 WP @ 500 g/ha was the most effective against whitefly in greengram.

**Table 3 : Effect of different insecticides against *A. craccivora* on blackgram**

| Sr. No. | Treatments | Dose (%) | Mean no. of *A. craccivora* / leaf | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | BS | 1 DAS | 2 DAS | 3 DAS | 7 DAS | Pooled |
| 1. | Imidacloprid 17.8% SL | 0.005 | 1.77(2.67) | 1.50(1.78) | 1.05(0.60) | 0.79(0.13) | 0.75(0.07) | 1.07(0.65) |
| 2. | Acetamiprid 20% SP | 0.004 | 1.77(2.65) | 1.48(1.70) | 1.07(0.65) | 0.82(0.18) | 0.78(0.12) | 1.08(0.66) |
| 3. | Clothianidin 50 % WDG | 0.003 | 1.75(2.57) | 1.40(1.48) | 0.98(0.47) | 0.77(0.10) | 0.75(0.07) | 1.01(0.53) |
| 4. | Novaluron 10% EC | 0.0075 | 1.76(2.62) | 1.70(2.40) | 1.30(1.20) | 1.14(0.83) | 0.88(0.28) | 1.29(1.18) |
| 5. | Spinosad 2.5% SC | 0.002 | 1.76(2.60) | 1.64(2.22) | 1.25(1.08) | 1.05(0.60) | 0.87(0.27) | 1.24(1.04) |
| 6. | Thiamethoxam 25% WG | 0.005 | 1.78(2.67) | 1.56(1.95) | 1.10(0.73) | 0.85(0.23) | 0.75(0.07) | 1.11(0.75) |
| 7. | Thiodicarb 75% WP | 0.10 | 1.77(2.63) | 1.61(2.21) | 1.22(1.00) | 0.98(0.48) | 0.94(0.38) | 1.22(1.00) |
| 8. | Fipronil 5% SC | 0.005 | 1.76(2.62) | 1.60(2.08) | 1.16(0.88) | 0.90(0.32) | 0.87(0.28) | 1.18(0.89) |
| 9. | Emamectin benzoate 5% WG | 0.002 | 1.79(2.72) | 1.71(2.43) | 1.38(1.42) | 1.25(1.07) | 0.98(0.47) | 1.36(1.35) |
| 10. | Monocrotophos 36% WSC | 0.04 | 1.78(2.67) | 1.73(2.50) | 1.45(1.62) | 1.30(1.22) | 1.03(0.57) | 1.40(1.48) |
| 11. | Endosulfan 35% EC | 0.075 | 1.74(2.55) | 1.65(2.23) | 1.29(1.18) | 1.09(0.70) | 0.93(0.38) | 1.27(1.13) |
| 12. | Control | - | 1.76(2.63) | 1.78(2.67) | 1.67(2.30) | 1.65(2.22) | 1.69(2.35) | 1.70(2.38) |
| S.E. ± | | | 0.07 | 0.07 | 0.07 | 0.06 | 0.03 | 0.03 |
| C.D. (P = 0.05) | | | NS | 0.20 | 0.20 | 0.18 | 0.08 | 0.08 |
| S.E. ± (P×T) | | | - | - | - | - | - | 0.06 |
| C.D. ( P = 0.05) (P×T) | | | - | - | - | - | - | 0.18 |
| C.V. (%) | | | 7.73 | 8.68 | 11.42 | 11.88 | 11.53 | 8.61 |

BS = Before spray; DAS = Days after spray; NS = Non-significant; *Figures in parentheses are retransformed values, those outside parentheses are square root transformed values ($\sqrt{x} + 0.5$)

**Table 4 : Effect of different insecticides against *M. testulalis* on blackgram**

| Sr. No. | Treatments | Dose (%) | Mean no. of M. testulalis / plant | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | BS | 1 DAS | 2 DAS | 3 DAS | 7 DAS | Pooled |
| 1. | Imidacloprid 17.8% SL | 0.005 | 1.70(2.40) | 1.53(1.85) | 1.47(1.65) | 1.39(1.45) | 1.38(1.40) | 1.44(1.59) |
| 2. | Acetamiprid 20% SP | 0.004 | 1.74(2.55) | 1.51(1.80) | 1.36(1.40) | 1.27(1.15) | 1.30(1.25) | 1.37(1.40) |
| 3. | Clothianidin 50 % WDG | 0.003 | 1.70(2.40) | 1.53(1.85) | 1.43(1.55) | 1.30(1.20) | 1.33(1.30) | 1.40(1.48) |
| 4. | Novaluron 10% EC | 0.0075 | 1.73(2.50) | 1.56(1.95) | 1.39(1.45) | 1.24(1.05) | 0.89(0.30) | 1.30(1.19) |
| 5. | Spinosad 2.5% SC | 0.002 | 1.69(2.35) | 1.33(1.30) | 1.11(0.75) | 0.86(0.25) | 0.84(0.20) | 1.06(0.63) |
| 6. | Thiamethoxam 25% WG | 0.005 | 1.77(2.65) | 1.56(1.95) | 1.44(1.60) | 1.29(1.20) | 1.38(1.40) | 1.42(1.54) |
| 7. | Thiodicarb 75% WP | 0.10 | 1.62(2.15) | 1.35(1.35) | 1.16(0.85) | 0.86(0.25) | 0.92(0.35) | 1.09(0.70) |
| 8. | Fipronil 5% SC | 0.005 | 1.71(2.45) | 1.39(1.45) | 1.22(1.00) | 0.89(0.30) | 0.97(0.45) | 1.14(0.80) |
| 9. | Emamectin benzoate 5% WG | 0.002 | 1.73(2.50) | 1.43(1.55) | 1.24(1.05) | 0.95(0.40) | 0.92(0.35) | 1.16(0.84) |
| 10. | Monocrotophos 36% WSC | 0.04 | 1.77(2.65) | 1.61(2.10) | 1.98(2.00) | 1.56(1.95) | 0.94(0.40) | 1.45(1.61) |
| 11. | Endosulfan 35% EC | 0.075 | 1.76(2.60) | 1.46(1.65) | 1.25(1.10) | 1.02(0.55) | 1.06(0.65) | 1.22(0.99) |
| 12. | Control | - | 1.63(2.15) | 1.64(2.20) | 1.68(2.35) | 1.66(2.30) | 1.74(2.55) | 1.69(2.35) |
| S.E. ± | | | 0.07 | 0.07 | 0.08 | 0.07 | 0.07 | 0.05 |
| C.D. (P = 0.05) | | | NS | 0.19 | 0.22 | 0.20 | 0.19 | 0.14 |
| S.E. ± (P×T) | | | - | - | - | - | - | 0.06 |
| C.D. (P = 0.05) (P×T) | | | - | - | - | - | - | 0.18 |
| C.V. % | | | 7.68 | 8.87 | 11.35 | 11.99 | 11.72 | 7.21 |

BS = Before spray; DAS = Days after spray; NS = Non- significant; *Figures in parentheses are retransformed values, those outside parentheses are square root transformed values ($\sqrt{x} + 0.5$)

Chhabra *et al*. (1993) reported that whitefly, *B. tabaci* can be effectively controlled by spraying crop with malathion 50 EC @ 950 ml or dimethoate 30 EC @ 625 ml or formation 50 EC @ 625 ml in 200 liter of water/ha on blackgram under Ludhiana condition. Ganpathy and Karuppiah (2004) found that thiamethoxam 0.2 g/lt. at 15 day after sowing was found the most effective treatment controlling whitefly infestation and gave the highest yield (800 kg/ha) in greengram. Patil (2006) observed that clothianidin 0.003 per cent was found to be the most effective insecticide against whitefly in greengram. Thus, the present findings are in corroboration with past reports.

**Aphid (*A. craccivora*) :**

The pooled data (Table 3) indicated that the lowest number of aphid was recorded in the treatment of clothianidin (0.53) and was at par with imidacloprid (0.65) and acetamiprid (0.66). Thiamethoxam (0.75), fipronil (0.89) and thiodicarb (1.00) were the next effective treatments. Remaining treatments *viz.*, spinosad (1.04), endosulfan (1.13), novaluron (1.18), emamectin benzoate (1.35) and monocrotophos (1.48) were least effective. The highest population of aphid (2.38) was noticed in control.

Khutwad *et al*. (2002) found that combination treatment *i.e.* 0.2 per cent seed treatment with thiamethoxam 70 WS + 0.02 per cent thiamethoxam 20 WG as foliar spray was effective rather than seed treatments and foliar spray alone for control of aphid in greengram. Patel and Srivastava (1990) reported that carbofuran @ 0.5 and 1.0 kg. a.i./ha and carbosulfan @5.00 a.i./100 g seeds (seed treatment) significantly improved plant growth and effectively controlled the aphid in greengram. In past, Patil (2006) found that lowest number of aphid was recorded in the treatment of clothianidin 0.003 per cent in greengram. The above report is in line with the present findings.

**Spotted pod borer (*M. testulalis*) :**

The data on third day after spraying (Table 4) revealed that spinosad (0.25) and thiodicarb (0.25) recorded lower number of spotted pod borer larvae. The pooled results over periods (Table 4) revealed that spinosad recorded lower number of spotted pod borer larvae (0.63) and it was at par with thiodicarb (0.70), fipronil (0.80) and emamectin benzoate (0.84). The next effective treatments in the order were endosulfan (0.99) and novaluron (1.19). The remaining treatments *viz.*, acetamiprid, clothianidin, thiamethoxam, monocrotophos and imidacloprid recorded 1.40, 1.48, 1.54, 1.59 and 1.61 larvae/plant, respectively. The maximum number of spotted pod borer larvae (2.35) was recorded in control.

In past, Patil (2006) revealed that spinosad 0.002 per cent recorded lower number of spotted pod borer in greengram. Thus, the present findings tallies with the above reports. Lal (1984) suggested control measures on increasing pulse production at ICAR, New Delhi. According to him, spraying the crop with either endosulfan 0.07 per cent or quinalphos 0.05 per cent at the time of pod formation was effective against

**Table 5 : Effect of different insecticides against *H. armigera* on blackgram**

| Sr. No. | Treatments | Dose (%) | Mean no. of *H. armigera* / plant | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | BS | 1 DAS | 2 DAS | 3 DAS | 7 DAS | Pooled |
| 1. | Imidacloprid 17.8% SL | 0.005 | 1.64(2.20) | 1.59(2.05) | 1.65(2.25) | 1.46(1.65) | 1.45(1.60) | 1.54(1.89) |
| 2. | Acetamiprid 20% SP | 0.004 | 1.69(2.35) | 1.58(2.00) | 1.57(2.00) | 1.34(1.35) | 1.38(1.45) | 1.47(1.70) |
| 3. | Clothianidin 50 % WDG | 0.003 | 1.66(2.25) | 1.59(2.05) | 1.62(2.15) | 1.36(1.40) | 1.40(1.50) | 1.50(1.78) |
| 4. | Novaluron 10% EC | 0.0075 | 1.67(2.30) | 1.63(2.15) | 1.59(2.05) | 1.32(1.25) | 1.00(0.50) | 1.41(1.49) |
| 5. | Spinosad 2.5% SC | 0.002 | 1.64(2.20) | 1.41(1.50) | 1.35(1.35) | 0.97(0.45) | 0.95(0.40) | 1.19(0.93) |
| 6. | Thiamethoxam 25% WG | 0.005 | 1.71(2.45) | 1.62(2.15) | 1.64(2.20) | 1.36(1.40) | 1.44(1.60) | 1.53(1.84) |
| 7. | Thiodicarb 75% WP | 0.10 | 1.61(2.10) | 1.43(1.55) | 1.37(1.45) | 0.97(0.45) | 1.02(0.55) | 1.22(1.00) |
| 8. | Fipronil 5% SC | 0.005 | 1.65(2.25) | 1.46(1.65) | 1.44(1.60) | 1.00(0.50) | 1.07(0.65) | 1.26(1.10) |
| 9. | Emamectin benzoate 5% WG | 0.002 | 1.67(2.30) | 1.50(1.75) | 1.46(1.65) | 1.05(1.60) | 1.02(0.55) | 1.28(1.14) |
| 10. | Monocrotophos 36% WSC | 0.04 | 1.71(2.45) | 1.67(2.30) | 1.76(2.60) | 1.63(2.15) | 1.04(0.60) | 1.55(1.91) |
| 11. | Endosulfan 35% EC | 0.075 | 1.70(2.40) | 1.53(1.85) | 1.47(1.70) | 1.12(0.75) | 1.15(0.85) | 1.34(1.29) |
| 12. | Control | - | 1.64(2.20) | 1.70(2.40) | 1.85(2.95) | 1.72(2.50) | 1.79(2.75) | 1.77(2.65) |
| S.E. ± | | | 0.07 | 0.06 | 0.09 | 0.08 | 0.07 | 0.05 |
| C.D. (P = 0.05) | | | NS | 0.18 | 0.26 | 0.22 | 0.20 | 0.15 |
| S.E. ± (P×T) | | | - | - | - | - | - | 0.06 |
| C.D. (P = 0.05)(P×T) | | | - | - | - | - | - | 0.18 |
| C.V. (%) | | | 7.84 | 8.12 | 11.60 | 11.90 | 11.62 | 7.35 |

BS = Before spray; DAS = Days after spray; NS = Non- significant; *Figures in parentheses are retransformed values, those outside parentheses are square root transformed values ($\sqrt{x + 0.5}$)

pod borer complex. Sukul *et al*. (1987) reported that cypermethrin 0.02 per cent and fenvalerate 0.02 per cent found to be better than permethrin and cypermethrin in controlling the pod borer on greengram at IARI, New Delhi.

**Gram pod borer (*H.armigera*) :**

The data recorded on third day after spraying (Table 5) revealed that spinosad (0.45) and thiodicarb (0.45) were more effective treatments. The perusal of the data (Table 5) recorded at seventh day after spraying indicated that spinosad recorded lower number of *H. armigera* (0.40). The pooled results (Table 5) over period revealed that spinosad (0.93) was found to be most effective treatments against *H. armigera.* The maximum number of larvae of *H. armigera* (2.65) was recorded in control.

According to Patil (2006), spinosad 0.002 per cent and Dipel-8L 0.02 per cent were the most effective treatments for controlling the gram pod borer. Thus, present findings are tallies with above reports. Ahmad *et al*. (1998) reported that two application of dimethoate 0.03 per cent or monocrotophos 0.04 per cent were effective against lepidopteran pod borers on blackgram. Dar *et al*. (2002) found that endosulfan 0.07 per cent was the most effective against pod borer on blackgram. Bhalani and Parsana (1986) reported that cypermethrin 0.004 per cent, fenvalerate 0.01 per cent, endosulfan 0.007 per cent, monocrotophos 0.04 per cent and carbary l 0.2 per cent were the most effective treatments in reducing the incidence of *H. armigera* on greengram under Gujarat condition.

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