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# Effect of Bg-Ii Cotton Hybrids and Non Bt Cotton On Weight Of Different Instars Of *Spodoptera Litura* (Fab.)

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***Abstract: Laboratory evaluation of eleven Bt cotton cultivars expressing both Cry1Ac and Cry2Ab endotoxins (BT-II) and non Bt cotton on weight of first, second, third and fourth instar larvae of Spodoptera litura. Different plant parts were used i.e. leaves, squares and bolls at 60, 75, 90 and 125 days after sowing of the crop for bioassay. First instar larvae fed on leaves and bolls shows hundred per cent mortality. The final weight of the each instar was reduced at seven days after feeding when compared to non Bt cotton. Reduced in weight was more in case of first, second and third instar than fourth instar larvae. Among leaves, squares and bolls reduction in weight of all four instars was more on leaves followed by squares and bolls***

***Keywords: Dual Toxin bt Cotton, Different Plant Parts, Non bt Cotton, s. Litura, Weight.***

## I. INTRODUCTION

Transgenic cotton, *Gossypium hirsutum*(L.), expressing insecticidal $\delta$-endotoxin protein of *Bacillus thuringiensis* Berliner, hereafter referred as Bt cotton (1).The introduction of Bt transgenic cotton hybrids in the year 2002-03 in all the cotton growing tracts of Andhra Pradesh revolutionized boll worm management of cotton resulting in a total shift in pesticide use pattern in the crop (2). The single (Cry 1 Ac) gene Bt transgenic hybrids are highly resistant to boll worms, especially American boll worm, *Helicoverpa armigera* affording very good protection from this pest (2). Leaf worm, Spodoptera *litura* Fab. (Noctuidae: Lepidoptera) is one of the most destructive pests of cotton, which feeds on foliage and sometimes young green bolls. It was a secondary pest of cotton (3). However transgenic Bt cotton with Cry1Ac proved not to be effective against *S. litura* (4, 5, 6, 7, 8, 9). So, the BG-I cotton is slowly replaced by BG-II expressing dual genes (Cry 1Ac+Cry2Ab). Bollgard-II cotton expressing both Cry1Ac and Cry2Ab proteins have provided increased efficacy against the budworm-bollworm complex and enhanced spectrum of activity against beet armyworm, *Spodoptera exigua* (Hub.) fall armyworm, *Spodoptera frugiperda* (Smith) and common cutworm or tobacco caterpillar *Spodoptera litura* (Fab.) which have been predicted to be major pests in emerging scenario (10, 11, 12).

In all most all the reports related to bioefficacy of Bt toxins the stage of the insect considered appeared to be neonates only. It is quite natural that the neonates are highly susceptible to these toxicants and life begins with egg stage. Thus the neonate mortality data represented the phenomenon that naturally occurs in the field. However, the decline in resistance or poor expression might have lead to survival of insects till adult stage. Survival of larvae up to late instars would lead to enhanced damage and acquisition ofresistance. The dreaded pests H. *armigera* and *S. litura* have many alternate cultivated hosts like pigeon pea, castor, ground nut etc which are presently not Bt cultivars. Due to plant protection in these crops migration of different instars to Bt cotton could not be ruled out. The efficacy of Bt toxins expressed in cotton plants may not be sufficient to contain grown up larvae. Migration to cotton at later stage of crop growth is more prone to such problem. As such there are no studies to compare instar wise efficacy of Cry toxins using discrete generations. Since literature available is very scanty the present investigation was undertaken in laboratory to analyse the effect of different plant parts of BG-II cotton on weight of different instars of *S. litura* at different stages of crop growth.

 

## II.MATERIALS AND METHODS

Laboratory experiments were carried out during 2013-14 to study the effect of eleven BG-II cotton hybrids *viz.*, Ajeeth-155, Ankur-3034, Chetak, ATM, Bhakti, Brahma, Rasi-665, Rasi-668, Denim, Sudarshan, Yuva and non Bt cotton plant parts (leaves, squares and bolls) as control against first, second, third and fourth instar larvae of *S. litura* at 60, 75, 90 and 125 DAS.

Eleven BG-II cotton hybrids and non Bt cotton plots were maintained at College Farm, College of Agriculture, Rajendranagar, Hyderabad during Kharif-2013. These plots were maintained by standard agronomic practices, including herbicide and fertilizer applications. Without insecticide application *S. litura* culture was maintained at BT lab, Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad. Initially the culture was collected from the field on castor plants and reared on castor leaves in BT lab at room temperature. Immediately after first generation the experiments was conducted with the first, second, third and fourth instar larvae.

Leaves, squares and bolls were plucked with 0.5 cm of petiole remaining to prevent desiccation from the crop of 60, 75, 90 and 125 days old dual toxin Bt cotton hybrids and non Bt cotton. Later these were cleaned with distilled water and wiped off with blotting paper to remove excess moisture and air dried. The cleaned leaves, squares and bolls were placed after suitably trimming (to fit into the cups) individually into rearing cups. Within 1-2 h of harvesting, a single leaf/ 3-4 squares/ one boll were placed into individual rearing cups and larvae were placed into each cup. *S. litura* larval instars cultured on natural diet were used, three replications of 15 larvae for each treatment kept in rearing cups at ambient temperature in laboratory.
The leaves, squares and bolls were changed at 24hrs interval and fecal pellets and dead larvae were removed from the cups every 24hrs.

A.Treatments

| Instars/treatments | First Instar | Second Instar | Third Instar | Fourth Instar |
|---|---|---|---|---|
| Treatments (Eleven BG-II hybrids) | Leaves (60, 75, 90 and 125 DAS) | Leaves (60, 75, 90 and 125 DAS) | Leaves (60, 75, 90 and 125 DAS) | Leaves (60, 75, 90 and 125 DAS) |
| | Squares (60, 75, 90 and 125 DAS) | Squares (60, 75, 90 and 125 DAS) | Squares (60, 75, 90 and 125 DAS) | Squares (60, 75, 90 and 125 DAS) |
| | | Bolls (90 and 125 DAS) | Bolls (90 and 125 DAS) | Bolls (90 and 125 DAS) |
| Control (Non Bt cotton) | Leaves (60, 75, 90 and 125 DAS) | Leaves (60, 75, 90 and 125 DAS) | Leaves (60, 75, 90 and 125 DAS) | Leaves (60, 75, 90 and 125 DAS) |
| | Squares (60, 75, 90 and 125 DAS) | Squares (60, 75, 90 and 125 DAS) | Squares (60, 75, 90 and 125 DAS) | Squares (60, 75, 90 and 125 DAS) |
| | | Bolls (90 and 125 DAS) | Bolls (90 and 125 DAS) | Bolls (90 and 125 DAS) |

Mortality was calculated at 24hrs intervals for seven days.

The data recorded on weight of *S. litura* larvae on Bollgard-II cotton were subjected to completely randomized design (CRD) (13). The CRD analysis was done by using the statistical programme opstat.

## III. RESULTS AND DISCUSSION

*A.Leaves*

First instar larvae of *S. litura* were more susceptible to leaves and squares of dual toxin hybrids than non Bt cotton. The weight of the first instar larvae was not recorded at seven days after release due to the 100 per cent mortality on leaves of BG-II cotton.

The weight of second, third and fourth instar larvae fed on BG-II cotton hybrid was significantly different from non-Bt cotton. In case of second, third and fourth instar larvae the weight ranged in between 0.021-0.046, 0.071-0.109, 0.191-0.284g per larvae at 60 DAS, 0.021-0.045, 0.069-0.086, 0.175-0.242g per larvae at 75 DAS, 0.025-0.050, 0.071-0.129, 0.173-0.251g per larvae at 90 DAS and 0.025-0.053, 0.055-0.101, 0.175-0.237g per larvae at 125 DAS, respectively (Table 1).

The weight of second, third and fourth instar larvae of *S. litura* fed with leaves of eleven BG-II cotton hybrids were low when compared to non-Bt leaves (Table 1). Minimum weight of second, third and fourth instar larvae was recorded as 0.021, 0.055 and 0.173 g per larvae, respectively at seven days after release. Similar results were also obtained by (14) where in 0.016, 0.035 and 0.059 g per larval weight was observed in *S. litura* larvae fed with BG-II cotton hybrid leaves at 72 h after release.

 

The lowest weight of second, third and fourth instar larvae of *S. litura* was recorded on Rasi-665 BG-II hybrid. These observations were similar with the results of (15) the weight of the larvae fed with dual toxin Bt cultivars was significantly reduced compared to the larvae fed with Bt and non-Bt cultivars and the reduction in the larval weight progressively increased from 24 to 72 h of feeding up to fifth instar and there was no significant difference in larval weights that were fed with Bt and non-Bt hybrids.

*B.Squares*

With regard to squares, the weight of first to fourth instar larvae on BG-II cotton hybrid was significantly different from non-Bt. The weight of first, second, third and fourth instar larvae fed with squares of eleven BG-II cotton hybrids at 60, 75, 90 and 125 DAS ranged in between 0.009-0.015, 0.020-0.052, 0.074-0.099, 0.193-0.235 g per larvae,0.005-0.013, 0.021-0.039, 0.066-0.094, 0.177-0.226 g per larvae,0.007-0.012, 0.026-0.041, 0.064-0.107, 0.191-0.240 g per larvae,0.007-0.012, 0.024-0.036, 0.055-0.099, 0.175-0.234g per larvae, respectively.

Minimum weight of first, second, third and fourth instar larvae fed with squares of BG-II cotton hybrids was recorded as 0.009, 0.020, 0.055 and 0.175 g per larvae at seven days after release in between 60 and 125 DAS (Table 2 and 3). Similar results were also obtained by (14), where the weight of second, third and fourth instar larvae was 0.020, 0.039 and 0.066 g per larvae when fed with BGII cotton hybrids squares at 72 h after release.

Among eleven BG-II cotton hybrids Rasi-665 recorded lowest weight on squares at 60, 75, 90 and 125 DAS. On non-Bt the weight was more when compared to eleven BG-II cotton hybrids. The weight was less on squares, compared to leaves. These findings are in line with the results of (14).

*C.Bolls*

Regarding the the first instar larvae hundred percent mortality was observed on the bolls. The results on weight of the second, third and fourth instar larvae fed on bolls revealed that of second, third and fourth instar larvae fed with bolls of BG-II cotton hybrid was recorded as 0.017, 0.053 and 0.191 g per larvae at seven days after release in between 60 and 125 DAS (Table 4). Among all eleven BG-II cotton hybrids minimum weight of second, third and fourth instars at 90 and 125 DAS was recorded on bolls of Rasi-665.

On leaves, squares and bolls the weight of first, second, third and fourth instar larvae on BG-II cotton hybrids was significantly different from non-Bt cotton. However, statistically all eleven BG-II cotton hybrids were on par with each other. Rasi-665 BG-II cotton recorded minimum weight of first, second, third and fourth instar in between 60 and 125 DAS. The present results suggest that dual toxin Bt cottons will provide substantially better control of *S. litura.*

Results from our experiment concluded that the BG-II is more effective than Bt cotton in controlling the different instar of *S. litura* larvae. Among the different plant parts leaves are good in controlling the *S. litura* larvae at 75 days after sowing of the crop. Within the instars first and second instars weight was very less than the third and fourth instar larvae.

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**TABLE I**
**EFFECT OF TEST HYBRID LEAVES ON LARVAL WEIGHT OF *S. litura*.**

| Treatments | Weight of Second Instar larvae (g) | | | | Weight of third Instar larvae (g) | | | | Weight of fourth Instar larvae (g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 DAS | 75 DAS | 90 DAS | 125 DAS | 60 DAS | 75 DAS | 90 DAS | 125 DAS | 60 DAS | 75 DAS | 90 DAS | 125 DAS |
| **Ankur-3034** | 0.037 (1.02)$^{a}$ | 0.045 (1.02)$^{a}$ | 0.050 (1.03)$^{a}$ | 0.034 (1.02)$^{a}$ | 0.082 (1.04)$^{a}$ | 0.070 (1.04)$^{a}$ | 0.120 (1.06)$^{a}$ | 0.101 (1.05)$^{a}$ | 0.192 (1.09)$^{a}$ | 0.218 (1.10)$^{a}$ | 0.248 (1.12)$^{a}$ | 0.224 (1.11)$^{a}$ |
| **Ajeet-155** | 0.046 (1.02)$^{a}$ | 0.042 (1.02)$^{a}$ | 0.032 (1.02)$^{a}$ | 0.036 (1.02)$^{a}$ | 0.109 (1.05)$^{a}$ | 0.086 (1.04)$^{a}$ | 0.089 (1.04)$^{a}$ | 0.063 (1.03)$^{a}$ | 0.265 (1.13)$^{a}$ | 0.230 (1.11)$^{a}$ | 0.251 (1.12)$^{a}$ | 0.237 (1.11)$^{a}$ |
| **Chetak** | 0.046 (1.02)$^{a}$ | 0.034 (1.02)$^{a}$ | 0.038 (1.02)$^{a}$ | 0.032 (1.02)$^{a}$ | 0.097 (1.05)$^{a}$ | 0.086 (1.04)$^{a}$ | 0.087 (1.04)$^{a}$ | 0.069 (1.03)$^{a}$ | 0.281 (1.13)$^{a}$ | 0.225 (1.11)$^{a}$ | 0.248 (1.12)$^{a}$ | 0.233 (1.11)$^{a}$ |
| **ATM** | 0.031 (1.02)$^{a}$ | 0.038 (1.02)$^{a}$ | 0.042 (1.02)$^{a}$ | 0.036 (1.02)$^{a}$ | 0.091 (1.05)$^{a}$ | 0.069 (1.03)$^{a}$ | 0.074 (1.04)$^{a}$ | 0.062 (1.03)$^{a}$ | 0.210 (1.10)$^{a}$ | 0.201 (1.10)$^{a}$ | 0.235 (1.11)$^{a}$ | 0.224 (1.11)$^{a}$ |
| **Bhakti** | 0.023 (1.01)$^{a}$ | 0.038 (1.02)$^{a}$ | 0.037 (1.02)$^{a}$ | 0.025 (1.01)$^{a}$ | 0.084 (1.04)$^{a}$ | 0.086 (1.04)$^{a}$ | 0.072 (1.04)$^{a}$ | 0.072 (1.04)$^{a}$ | 0.254 (1.12)$^{a}$ | 0.221 (1.11)$^{a}$ | 0.209 (1.10)$^{a}$ | 0.231 (1.10)$^{a}$ |
| **Brahma** | 0.028 (1.01)$^{a}$ | 0.039 (1.02)$^{a}$ | 0.040 (1.020)$^{a}$ | 0.027 (1.01)$^{a}$ | 0.093 (1.05)$^{a}$ | 0.078 (1.04)$^{a}$ | 0.129 (1.06)$^{a}$ | 0.061 (1.03)$^{a}$ | 0.210 (1.10)$^{a}$ | 0.195 (1.09)$^{a}$ | 0.215 (1.10)$^{a}$ | 0.212 (1.10)$^{a}$ |
| **Denim** | 0.028 (1.01)$^{a}$ | 0.022 (1.01)$^{a}$ | 0.035 (1.02)$^{a}$ | 0.032 (1.02)$^{a}$ | 0.087 (1.04)$^{a}$ | 0.072 (1.04)$^{a}$ | 0.112 (1.05)$^{a}$ | 0.058 (1.03)$^{a}$ | 0.284 (1.13)$^{a}$ | 0.187 (1.09)$^{a}$ | 0.223 (1.11)$^{a}$ | 0.217 (1.10)$^{a}$ |
| **Rasi-665** | 0.021 (1.01)$^{a}$ | 0.021 (1.01)$^{a}$ | 0.025 (1.01)$^{a}$ | 0.025 (1.01)$^{a}$ | 0.093 (1.05)$^{a}$ | 0.069 (1.03)$^{a}$ | 0.071 (1.04)$^{a}$ | 0.055 (1.03)$^{a}$ | 0.191 (1.09)$^{a}$ | 0.175 (1.08)$^{a}$ | 0.173 (1.08)$^{a}$ | 0.175 (1.10)$^{a}$ |
| **Rasi-668** | 0.026 (1.01)$^{a}$ | 0.027 (1.01)$^{a}$ | 0.028 (1.01)$^{a}$ | 0.027 (1.01)$^{a}$ | 0.071 (1.04)$^{a}$ | 0.082 (1.04)$^{a}$ | 0.084 (1.04)$^{a}$ | 0.061 (1.03)$^{a}$ | 0.198 (1.10)$^{a}$ | 0.198 (1.10)$^{a}$ | 0.201 (1.10)$^{a}$ | 0.217 (1.10)$^{a}$ |
| **Sudarshan** | 0.025 (1.01)$^{a}$ | 0.036 (1.02)$^{a}$ | 0.034 (1.02)$^{a}$ | 0.040 (1.02)$^{a}$ | 0.101 (1.05)$^{a}$ | 0.078 (1.04)$^{a}$ | 0.083 (1.04)$^{a}$ | 0.083 (1.04)$^{a}$ | 0.252 (1.12)$^{a}$ | 0.189 (1.10)$^{a}$ | 0.208 (1.10)$^{a}$ | 0.177 (1.09)$^{a}$ |
| **Yuva** | 0.026 (1.01)$^{a}$ | 0.043 (1.02)$^{a}$ | 0.033 (1.02)$^{a}$ | 0.053 (1.03)$^{a}$ | 0.087 (1.04)$^{a}$ | 0.081 (1.04)$^{a}$ | 0.089 (1.04)$^{a}$ | 0.091 (1.05)$^{a}$ | 0.226 (1.11)$^{a}$ | 0.242 (1.11)$^{a}$ | 0.185 (1.09)$^{a}$ | 0.233 (1.11)$^{a}$ |
| **Control** | 0.032 (1.02)$^{a}$ | 0.048 (1.02)$^{a}$ | 0.033 (1.02)$^{a}$ | 0.038 (1.02)$^{a}$ | 0.09 (1.04)$^{a}$ | 0.087 (1.04)$^{a}$ | 0.096 (1.05)$^{a}$ | 0.084 (1.04)$^{a}$ | 0.231 (1.11)$^{a}$ | 0.287 (1.13)$^{a}$ | 0.239 (1.11)$^{a}$ | 0.256 (1.12)$^{a}$ |
| **CD** | 0.004 | 0.005 | 0.004 | 0.003 | 0.004 | 0.005 | 0.009 | 0.003 | 0.026 | 0.01 | 0.005 | 0.008 |
| **SE (m)** | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.002 | 0.003 | 0.001 | 0.01 | 0.004 | 0.002 | 0.003 |

Figures in parentheses are square root transformed values; numbers followed by same superscript are not statistically different.
*First instar recorded 100 per cent mortality.

**TABLE 2**
**EFFECT OF TEST HYBRID SQUARES ON WEIGHT OF FIRST AND SECOND INSTAR LARVAE OF *S. litura*.**

| Treatments | Weight of first Instar larvae (g) | | | | Weight of second Instar larvae (g) | | | |
|---|---|---|---|---|---|---|---|---|
| | 60 DAS | 75 DAS | 90 DAS | 125 DAS | 60 DAS | 75 DAS | 90 DAS | 125 DAS |
| **Ankur-3034** | 0.010 (1.01)[a] | 0.010 (1.01)[a] | 0.011 (1.01)[a] | 0.009 (1.01)[a] | 0.028 (1.01)[a] | 0.024 (1.01)[a] | 0.038 (1.02)[a] | 0.033 (1.02)[a] |
| **Ajeet-155** | 0.015 (1.01)[a] | 0.013 (1.01)[a] | 0.012 (1.01)[a] | 0.012 (1.01)[a] | 0.052 (1.03)[a] | 0.039 (1.02)[a] | 0.041 (1.02)[a] | 0.036 (1.02)[a] |
| **Chetak** | 0.011 (1.01)[a] | 0.009 (1.00)[a] | 0.010 (1.01)[a] | 0.011 (1.01)[a] | 0.038 (1.02)[a] | 0.033 (1.02)[a] | 0.032 (1.02)[a] | 0.031 (1.02)[a] |
| **ATM** | 0.009 (1.01)[a] | 0.008 (1.00)[a] | 0.008 (1.00)[a] | 0.010 (1.01)[a] | 0.022 (1.01)[a] | 0.021 (1.01)[a] | 0.035 (1.02)[a] | 0.029 (1.01)[a] |
| **Bhakti** | 0.010 (1.01)[a] | 0.009 (1.00)[a] | 0.008 (1.00)[a] | 0.010 (1.01)[a] | 0.028 (1.01)[a] | 0.035 (1.02)[a] | 0.033 (1.02)[a] | 0.029 (1.01)[a] |
| **Brahma** | 0.010 (1.01)[a] | 0.008 (1.00)[a] | 0.012 (1.01)[a] | 0.011 (1.01)[a] | 0.027 (1.01)[a] | 0.030 (1.02)[a] | 0.041 (1.02)[a] | 0.028 (1.01)[a] |
| **Denim** | 0.010 (1.01)[a] | 0.008 (1.00)[a] | 0.009 (1.00)[a] | 0.007 (1.00)[a] | 0.033 (1.02)[a] | 0.030 (1.02)[a] | 0.041 (1.02)[a] | 0.027 (1.01)[a] |
| **Rasi-665** | 0.009 (1.01)[a] | 0.005 (1.00)[a] | 0.007 (1.00[a] | 0.007 (1.00)[a] | 0.020 (1.01)[a] | 0.021 (1.01)[a] | 0.026 (1.01)[a] | 0.024 (1.01)[a] |
| **Rasi-668** | 0.009 (1.00)[a] | 0.011 (1.01)[a] | 0.011 (1.01)[a] | 0.009 (1.01)[a] | 0.034 (1.02)[a] | 0.025 (1.01)[a] | 0.029 (1.01)[a] | 0.027 (1.01)[a] |
| **Sudarshan** | 0.009 (1.01)[a] | 0.008 (1.00)[a] | 0.009 (1.00)[a] | 0.009 (1.00)[a] | 0.035 (1.02)[a] | 0.033 (1.02)[a] | 0.038 (1.02)[a] | 0.029 (1.01)[a] |
| **Yuva** | 0.012 (1.01)[a] | 0.012 (1.01)[a] | 0.012 (1.01)[a] | 0.012 (1.01)[a] | 0.043 (1.02)[a] | 0.029 (1.02)[a] | 0.035 (1.02)[a] | 0.031 (1.02)[a] |
| **Control** | 0.010 (1.01)[a] | 0.015 (1.01)[a] | 0.016 (1.01)[a] | 0.015 (1.01)[a] | 0.046 (1.02)[a] | 0.038 (1.02)[a] | 0.033 (1.02)[a] | 0.031 (1.02)[a] |
| **CD** | 0.001 | 0.001 | 0.001 | 0.001 | 0.004 | 0.003 | 0.002 | 0.002 |
| **SE (m)** | 0 | 0 | 0 | 0 | 0.001 | 0.001 | 0.001 | 0.001 |

Figures in parentheses are square root transformed values; numbers followed by same superscript are not statistically different.

 

**TABLE 3**
**EFFECT OF TEST HYBRID SQUARES ON WEIGHT OF THIRD AND FOURTH INSTAR LARVAE OF *S. litura*.**

| Treatments | Weight of third Instar larvae (g) | | | | Weight of fourth Instar larvae (g) | | | |
|---|---|---|---|---|---|---|---|---|
| | 60 DAS | 75 DAS | 90 DAS | 125 DAS | 60 DAS | 75 DAS | 90 DAS | 125 DAS |
| **Ankur-3034** | 0.076 (1.04)[a] | 0.075 (1.04)[a] | 0.096 (1.05)[a] | 0.080 (1.04)[a] | 0.198 (1.10)[a] | 0.192 (1.09)[a] | 0.196 (1.09)[a] | 0.181 (1.09)[a] |
| **Ajeet-155** | 0.099 (1.05)[a] | 0.094 (1.05)[a] | 0.107 (1.05)[a] | 0.099 (1.05)[a] | 0.222 (1.11)[a] | 0.226 (1.11)[a] | 0.234 (1.11)[a] | 0.221 (1.11)[a] |
| **Chetak** | 0.088 (1.04)[a] | 0.081 (1.04)[a] | 0.082 (1.04)[a] | 0.070 (1.04)[a] | 0.216 (1.10)[a] | 0.187 (1.09)[a] | 0.215 (1.10)[a] | 0.188 (1.09)[a] |
| **ATM** | 0.090 (1.04)[a] | 0.069 (1.03)[a] | 0.079 (1.04)[a] | 0.065 (1.03)[a] | 0.196 (1.10)[a] | 0.199 (1.10)[a] | 0.208 (1.10)[a] | 0.193 (1.09)[a] |
| **Bhakti** | 0.091 (1.05)[a] | 0.089 (1.04)[a] | 0.064 (1.03)[a] | 0.083 (1.04)[a] | 0.235 (1.11)[a] | 0.189 (1.09)[a] | 0.214 (1.10)[a] | 0.201 (1.10)[a] |
| **Brahma** | 0.086 (1.04)[a] | 0.083 (1.04)[a] | 0.083 (1.04)[a] | 0.060 (1.03)[a] | 0.224 (1.11)[a] | 0.218 (1.10)[a] | 0.207 (1.10)[a] | 0.234 (1.11)[a] |
| **Denim** | 0.092 (1.05)[a] | 0.085 (1.04)[a] | 0.080 (1.04)[a] | 0.055 (1.03)[a] | 0.219 (1.10)[a] | 0.215 (1.10)[a] | 0.232 (1.11)[a] | 0.227 (1.10)[a] |
| **Rasi-665** | 0.074 (1.04)[a] | 0.066 (1.03)[a] | 0.077 (1.04)[a] | 0.058 (1.03)[a] | 0.199 (1.10)[a] | 0.177 (1.09)[a] | 0.191 (1.09)[a] | 0.175 (1.08)[a] |
| **Rasi-668** | 0.076 (1.04)[a] | 0.074 (1.04)[a] | 0.084 (1.04)[a] | 0.055 (1.03)[a] | 0.193 (1.09)[a] | 0.198 (1.02)[a] | 0.207 (1.10)[a] | 0.179 (1.08)[a] |
| **Sudarshan** | 0.091 (1.05)[a] | 0.088 (1.04)[a] | 0.090 (1.04)[a] | 0.082 (1.04)[a] | 0.209 (1.10)[a] | 0.197 (1.09)[a] | 0.213 (1.10)[a] | 0.177 (1.09)[a] |
| **Yuva** | 0.077 (1.04)[a] | 0.076 (1.04)[a] | 0.079 (1.04)[a] | 0.084 (1.04)[a] | 0.234 (1.11)[a] | 0.194 (1.09)[a] | 0.240 (1.11)[a] | 0.223 (1.11)[a] |
| **control** | 0.095 (1.05)[a] | 0.089 (1.04)[a] | 0.084 (1.04)[a] | 0.083 (1.04)[a] | 0.225 (1.11)[a] | 0.281 (1.13)[a] | 0.255 (1.12)[a] | 0.224 (1.11)[a] |
| **CD** | 0.005 | 0.004 | 0.003 | 0.005 | N.S. | 0.017 | 0.01 | 0.014 |
| **SE (m)** | 0.002 | 0.002 | 0.001 | 0.002 | 0.006 | 0.006 | 0.003 | 0.005 |

Figures in parentheses are square root transformed values; numbers followed by same superscript are not statistically different.

**TABLE 4**
**EFFECT OF TEST HYBRID BOLLS ON LARVAL WEIGHT OF *S. litura*.**

| **Treatments** | **Weight of second Instar larvae (g)** | | **Weight of third Instar larvae (g)** | | **Weight of fourth Instar larvae (g)** | |
|---|---|---|---|---|---|---|
| | **90 DAS** | **125 DAS** | **90 DAS** | **125 DAS** | **90 DAS** | **125 DAS** |
| **Ankur-3034** | 0.035 (1.02)[a] | 0.034 (1.02)[a] | 0.090 (1.04)[a] | 0.087 (1.04)[a] | 0.234 (1.11)[a] | 0.231 (1.11)[a] |
| **Ajeet-155** | 0.045 (1.02)[a] | 0.037 (1.02)[a] | 0.081 (1.04)[a] | 0.092 (1.05)[a] | 0.267 (1.13)[a] | 0.335 (1.16)[a] |
| **Chetak** | 0.029 (1.01)[a] | 0.028 (1.01)[a] | 0.087 (1.04)[a] | 0.083 (1.04)[a] | 0.211 (1.10)[a] | 0.228 (1.11)[a] |
| **ATM** | 0.033 (1.02)[a] | 0.029 (1.01)[a] | 0.084 (1.04)[a] | 0.089 (1.04)[a] | 0.204 (1.10)[a] | 0.267 (1.13)[a] |
| **Bhakti** | 0.028 (1.01)[a] | 0.028 (1.01)[a] | 0.086 (1.04)[a] | 0.086 (1.04)[a] | 0.255 (1.12)[a] | 0.271 (1.13)[a] |
| **Brahma** | 0.030 (1.02)[a] | 0.022 (1.01)[a] | 0.077 (1.04)[a] | 0.062 (1.03)[a] | 0.243 (1.12)[a] | 0.218 (1.10)[a] |
| **Denim** | 0.029 (1.01)[a] | 0.031 (1.02)[a] | 0.084 (1.04)[a] | 0.063 (1.03)[a] | 0.234 (1.11)[a] | 0.253 (1.12)[a] |
| **Rasi-665** | 0.024 (1.01)[a] | 0.017 (1.01)[a] | 0.073 (1.04)[a] | 0.053 (1.03)[a] | 0.191 (1.09)[a] | 0.249 (1.12)[a] |
| **Rasi-668** | 0.028 (1.01)[a] | 0.021 (1.01)[a] | 0.086 (1.04)[a] | 0.062 (1.03)[a] | 0.217 (1.10)[a] | 0.224 (1.11)[a] |
| **Sudarshan** | 0.033 (1.02)[a] | 0.043 (1.02)[a] | 0.083 (1.04)[a] | 0.082 (1.04)[a] | 0.191 (1.09)[a] | 0.313 (1.15)[a] |
| **Yuva** | 0.039 (1.02)[a] | 0.042 (1.02)[a] | 0.076 (1.04)[a] | 0.086 (1.04)[a] | 0.219 (1.104)[a] | 0.221 (1.11)[a] |
| **Control** | 0.030 (1.02)[a] | 0.031 (1.02)[a] | 0.090 (1.04)[a] | 0.087 (1.04)[a] | 0.252 (1.12)[a] | 0.371 (1.17)[a] |
| **CD** | 0.004 | 0.003 | 0.005 | 0.004 | 0.006 | 0.008 |
| **SE (m)** | 0.001 | 0.001 | 0.002 | 0.001 | 0.002 | 0.003 |

Figures in parentheses are square root transformed values; numbers followed by same superscript are not statistically different.

 