The Bioscan 9(1): 65-69, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

TEMPORAL AND INTRADAY ABUNDANCE VARIATIONS OF BLISTER BEETLE *(MYLABRIS PHALERATA)* ON GREENGRAM

K. S. PAWAR[1], S. P. DHAVAN[1] AND R. M. WADASKAR[2]*
[1]Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104, Maharastra, INDIA
[2]Pulses Resarch Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104, Maharashtra, INDIA
e-mail: rahulwadaskar@gmail.com

KEYWORDS
Blister beetle
Greengram
Crop phenology
Seasonal abundance
Intraday abundance
Pattern

Received on :
20.06.2013

Accepted on :
17.12.2013

***Corresponding author**

ABSTRACT
Temporal and intraday abundance variations of blister beetle (*Mylabris phalerata*) on greengram under regular and late sown condition were recorded at Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The abundance of blister beetle and crop phenology revealed population from bud initiation stage with a peak during flowering and early pod formation stage, clearly indicating its preference for the buds and flowers. Higher abundance of blister beetle adults during pod formation stage can be attributed to second flush of greengram. The beetle population decreased when the crop reached physiological maturity. Correlations of weather parameters with blister beetles abundance revealed that maximum temperature, minimum temperature and bright sunshine hours were significantly correlated in negative manner. Morning relative humidity and evening relative humidity had positive influence on blister beetle abundance. The number of rainy days and rainfall had positive correlation with seasonal abundance of the beetles, though the later being statistically non significant. Strong association of evaporation in negative manner was also evident. Thus, it may be inferred that the blister beetles population had preference for low temperature regime and less bright sunshine hours and more rainy days, indicating positive influence of rainfall. Highest feeding activity of adult blister beetles with orientation to sunlight was recorded during pre noon period whereas, most of the adult blister beetles preferred idleness (avoiding sunlight) post noon period. At dusk, adults preferred to congregate at higher position above crop canopy.

INTRODUCTION

Greengram (*Vigna radiata*: Leguminoceae), referred as "Queen of pulses" is the third most important pulse crop of India after chickpea and pigeonpea. Popularity of this short duration pulse crop is mainly because it can be grown like sole crop, mixed crop or as an intercrop. Blister beetle, *Mylabris sp.* (Coleoptera: Meloidae) are highly cosmopolitan and are reported to occur on pulse crops from tropical Tamil Nadu to temperate regions of Uttar Pradesh (Garg, 1985; Patnaik *et al.*, 1993). In Vidarbha region (Maharashtra state) blister beetles have assumed a major pest status in recent years, especially, on short-duration crops like greengram and blackgram. Blister beetles (*Mylabris phalerata*) inflicts huge losses on account of their association with flowering phase (Shende *et al.*, 2013). The adult beetles severely damage buds, flowers and even tender leaves by feeding either solitarily or gregariously. The damage caused to flower is so extensive that there is no pod and seed setting resulting in drastic yield reduction (Dhingra and Sarup, 1992).

Review of literature does not throw sufficient light on seasonal abundance pattern of blister beetles, influence of weather parameters on abundance and behavioral aspects of blister beetle. The information on these aspects is a prerequisite for formulating management strategy for blister beetles, Hence, the present study was framed to study the seasonal abundance pattern, association with crop phenology, correlation with weather parameters and intraday activity of blister beetle.

MATERIALS AND METHODS

Studies on the greengram blister beetle, *Mylabris phalerata*, with reference to its temporal activity was carried out at the Pulses Research Unit, Dr**.** Panjabrao Deshmukh Krishi Vidyapeeth, Akola during kharif 2011-12 regular sown crop and late sown crop and kharif 2012-13 regular sown crop, whereas, intraday abundance variations were recorded during kharif regular sown crop 2012-13. PKV green gold was used as test variety raised as per recommended package of practices under pesticide free condition.

Temporal activity of blister beetles

Large plot of greengram variety, PKV green gold (10 × 10 m) was used for recording temporal activity of blister beetle. Five spots each of meter row length (mrl) were randomly selected, labeled for recording the observations. The adult blister beetle counts were recorded daily under insecticide free condition. The data on seasonal abundance of blister beetles was correlated (simple linear correlation) with weather parameters to assess the relation of weather parameters with the pest incidence. The blister beetle abundance was also correlated with the crop phenology. (Dhavan *et al.*, 2013).

Intraday activity of blister beetles

Observations on intraday activity of blister beetles during peak flowering period was based on mean of five meter row lengths. Observations were recorded from 6:30 am to 7:30 pm at one

hour interval on no. of beetles per mrl, beetle activity and orientation.

RESULTS AND DISCUSSION

Data on seasonal incidence of blister beetle on greengram under timely sown condition (Table 1) was recorded from 1st August 2011 (31st meteorological week) when the crop was in the vegetative growth phase. The incidence of blister beetle was observed in the bud initiation stage from 10th August 2011 (32nd MW) with 0.4 blister beetles/mrl and a peak on 14th August 2011 (33rd MW) with count of 2.0 beetles per mrl. Flowering phase encountered gradual increasing trend of blister beetle abundance from 17th August 2011 indicating its preference for the flowering phase. Peak blister beetle count at flowering stage was recorded on 23rd august 2011 with 1.8 beetles per mrl (34th MW). Similar levels of populations were observed on flowering and pod formation stage. Maximum count of 2.4 beetles on 3rd and 7th September 2011. The blister beetle abundance then decreased gradually to 0.8 beetles per mrl (on 11th and 13th September 2011 - 37th MW) at physiological maturity stage.

The blister beetle count was higher during the pod formation stage of first flush, which can be attributed to second flush in variety PKV green gold. Higher abundance of blister beetles and subsequent damage translating in putting forth of second flush in variety PKV green gold. The recording of blister beetle abundance on daily basis gave strong correlation patterns with weather parameters as against observations recorded on weekly basis mainly because greengram is a short duration crop and the pest is confined to flowering phase.

Temporal activity of blister beetles on greengram under late sown condition was recorded from 3rd August 2011 (31st meteorological week). The incidence of blister beetle was observed in the bud initiation stage with a peak on 22nd August 2011 (34th MW) with 0.8 blister beetles/mrl. Flowering phase encountered higher blister beetles activity with a peak on 31st August 2011 with 1.6 beetles per mrl (35th MW), indicating its preference for the flowering phase. Even higher levels of populations were observed on flowering and pod formation stage with maximum count of 2.0 beetles on 2nd September 2011(35th MW), whereas, lower population counts of blister beetles was recorded during pod development stage. The decline in abundance trend continued with crop attaining physiological maturity. Higher population abundance can be attributed to the populations from regular sown crop which was in pod formation stage by the time late sown crop attained flowering phase.

During kharif 2012-13 under timely sown condition, blister beetles were recorded from 32nd MW at bud initiation stage. The peak of 0.6 blister beetle per mrl was recorded on 13th August 2012 during flowering phase in 33rd MW, whereas, peak of 0.8 blister beetles/mrl was recorded on on 14th and 18th August 2012 (33rd MW) during flowering + pod formation phase. Pod development phase registered decline in blister beetles abundance which continued in physiological maturity of crop with no population.

Ahad *et al*. (2011) also reported with incidence of blister beetle in maize from 29th metrological week, with maximum incidence in 33rd metrological week and less count in 37th metrological week which is in line of the present findings though the crop is different.

Seasonal abundance of blister beetles influenced by crop phenology

Season kharif 2011-12 - timely sown

Data in Table 2 on crop phenology and seasonal abundance of blister beetle on greengram during kharif 2011-12 (timely sown condition) revealed no blister beetles at vegetative stage. The blister beetle incidence was observed from 32nd meteorological week at bud initiation stage with blister beetle count of 0.4 beetles/mrl. 33rd and 34th meteorological week (flowering phase) had higher blister beetle count of 1.2 beetle/mrl, whereas, 35th meteorological week (Flowering + Pod formation) registered highest blister beetle abundance of 1.5 beetles/mrl, attributed to new flush. Peak beetle count of 2.4 beetles/mrl was recorded in 36th meteorological week when the crop was in pod development stage but with lot of flowers of second flush. The blister beetle abundance then declined consistently to a low of 0.6 blister beetles/mrl when the crop reached to 75 percent physiological maturity.

Season kharif 2011-12 - late sown

The observation on seasonal abundance of blister beetle on late sown green gram crop was recorded during kharif 2011-12. Similar to timely sown condition, no blister beetles were observed at vegetative stage. The blister beetle incidence was observed from 34th MW at bud initiation stage with blister beetle count of 0.4 beetles/mrl. 35th MW which coincided with flowering phase had higher blister beetle count of 1.4 beetle/mrl, indicating the affinity of adult beetles to greengram flowering phase irrespective of date of sowing. 36th MW (flowering + pod development) registered decline in blister beetle abundance which continued during 37th and 38th MW with pod development and physiological maturity stage.

Season kharif 2012-13 - timely sown

Abundance of blister beetle on timely sown greengram during kharif 2012-13 revealed that blister beetle population was not associated with the vegetative stage. Bud initiation stage had blister beetle count of 0. 4 beetle/mrl in 31st MW. 32rd (bud initiation + flowering), 33rd MW (flowering + pod formation) and 34th MW (pod development) had lower population count of 0.4, 0.2 and 0.2 blister beetles/mrl, respectively. In 35th and 36th MW when the crop attained physiological maturity and maturity, respectively, the blister beetle population was not observed.

These findings of present study could not be discussed for want of literature. The peak abundance of adults during flowering phase is supported by Dhamdhere *et al*. (1995) who reported blister beetle *Mylabris pustulata* activity from flowering to harvest of kharif brinjal, whereas, Durairaj and Ganapathy (1996) reported peak incidence (12.3-19.4 beetles plant^{-1}) between August and October, which coincides with the flowering periods of pigeonpea.

Correlation of blister beetle abundance with weather parameters

During kharif 2011-12, the simple linear correlation values

Table 1: Temporal activity of Blister beetles during 2011-12 and 2012-13

Date	MW	Season 1A	Crop phenology	Season 1B	Crop phenology	Season 2 A	Crop phenology
3.8.11	31	0.0	Vegetative	0.0	Vegetative	0.0	Vegetative
4.8.11		0.0	Vegetative	0.0	Vegetative	0.0	Bud initiation
5.8.11		0.0	Vegetative	0.0	Vegetative	0.0	Bud initiation
6.8.11	32	0.0	Vegetative	0.0	Vegetative	0.0	Bud initiation
7.8.11		0.0	Vegetative	0.0	Vegetative	0.0	Bud initiation
8.8.11		0.0	Vegetative	0.0	Vegetative	0.2	Bud initiation
9.8.11		0.0	Vegetative	0.0	Vegetative	0.4	Flowering
10.8.11		0.4	Bud initiation	0.0	Vegetative	0.2	Flowering
11.8.11		0.8	Bud initiation	0.0	Vegetative	0.4	Flowering
12.8.11		0.8	Bud initiation	0.0	Vegetative	0.4	Flowering
13.8.11	33	0.8	Bud initiation	0.0	Vegetative	0.6	Flowering
14.8.11		2.0	Bud initiation	0.0	Vegetative	0.8	Flowering + pod formation
15.8.11		1.2	Bud initiation	0.0	Vegetative	0.4	Flowering + pod formation
16.8.11		1.4	Flowering	0.0	Vegetative	0.2	Flowering + pod formation
17.8.11		1.2	Flowering	0.0	Vegetative	0.4	Flowering + pod formation
18.8.11		1.2	Flowering	0.0	Vegetative	0.8	Flowering + pod formation
19.8.11		1.4	Flowering	0.0	Vegetative	0.4	Flowering + pod formation
20.8.11	34	1.2	Flowering	0.0	Vegetative	0.4	Pod development
21.8.11		1.0	Flowering	0.2	Vegetative	0.6	Pod development
22.8.11		1.2	Flowering	0.8	Bud initiation	0.4	Pod development
23.8.11		1.8	Flowering + pod formation	0.6	Bud initiation	0.2	Pod development
24.8.11		1.2	Flowering + pod formation	0.6	Bud initiation	0.4	Pod development
25.8.11		1.4	Flowering + pod formation	0.4	Bud initiation	0.6	Pod development
26.8.11		1.0	Flowering + pod formation	0.4	Bud initiation	0.4	Pod development
27.8.11	35	1.2	Flowering + pod formation	0.6	Flowering	0.2	Pod development
28.8.11		1.0	Flowering + pod formation	0.6	Flowering	0.2	Pod development
29.8.11		1.0	Flowering + pod formation	1.0	Flowering	0.0	Pod development
30.8.11		1.2	Flowering + pod formation	0.6	Flowering	0.0	Physiological maturity
31.8.11		2.0	Pod development	1.6	Flowering	0.0	Physiological maturity
1.9.11		1.6	Pod development	1.4	Flowering	0.0	Physiological maturity
2.9.11		2.0	Pod development	2.0	Flowering + pod formation	0.0	Physiological maturity
3.9.11	36	2.4	Pod development	1.6	Flowering + pod formation	0.0	Physiological maturity
4.9.11		1.6	Pod development	1.4	Flowering + pod formation	0.0	Physiological maturity
5.9.11		1.0	Pod development	1.0	Flowering + pod formation	0.0	Maturity
6.9.11		1.8	Pod development	1.0	Flowering + pod formation	0.0	Maturity
7.9.11		2.4	Pod development	0.4	Pod development	0.0	Maturity
8.9.11		1.6	Pod development	0.6	Pod development	0.0	Maturity
9.9.11		1.4	Pod development	1.0	Pod development		
10.9.11	37	1.6	Pod development	0.6	Pod development		
11.9.11		0.8	Physiological maturity	0.4	Pod development		
12.9.11		0.6	Physiological maturity	0.6	Pod development		
13.9.11		0.8	Physiological maturity	0.2	Pod development		
14.9.11		0.6	Physiological maturity	0.4	Pod development		
15.9.11		0.6	Physiological maturity	0.4	Physiological maturity		
16.9.11	38	0.2	Physiological maturity				
17.9.11		0.2	Physiological maturity				
18.9.11		0.2	Physiological maturity				
19.9.11		0.0	Physiological maturity				

Season 1A - Adult Blister beetles/mrl on Greengram Timely sown (kharif 2011-12), Season 1B - Adult Blister beetles/mrl on Greengram late sown condition (Kharif 2011-12) and Season 2A - Adult Blister beetles/mrl on Greengram Timely sown (kharif 2012-13

Table 2: Seasonal abundance of Blister beetles as influenced by crop phenology during 2011-12 and 2012-13

MW	Crop phenology	Season 1A	MW	Crop phenology	Season 1B	MW	Crop phenology	Season 2A
30	Vegetative	0.0	31	Vegetative	0.0	29	Vegetative	0.0
31	Vegetative	0.0	32	Vegetative	0.0	30	Vegetative	0.0
32	Vegetative + bud initiation	0.4	33	Vegetative	0.0	31	Vegetative + bud initiation	0.4
33	Bud initiation + flowering	1.2	34	Bud initiation	0.4	32	Bud initiation + flowering	0.4
34	Flowering + Pod formation	1.2	35	Flowering	1.4	33	Flowering + Pod formation	0.2
35	Flowering + Pod development	2.0	36	Flowering + Pod development	0.6	34	Pod development	0.2
36	Pod development	2.4	37	Pod development	0.4	35	Pod development + physiological maturity	0.0
37	Physiological maturity	0.8	38	Physiological maturity	0.2	36	Maturity	0.0

Season 1A - Adult Blister beetles/mrl on Greengram Timely sown (kharif 2011-12), Season 1B - Adult Blister beetles/mrl on Greengram late sown condition (Kharif 2011-12) and Season 2A - Adult Blister beetles/mrl on Greengram Timely sown (kharif 2012-13

for association of weather parameters and blister beetles abundance on greengram under regular sown condition (Table 3), revealed that maximum temperature (r value = -0.389) and minimum temperature (r = -0.386) were significantly correlated in negative manner (p=0.01). Similar trend was observed in case of minimum temperature (r = -0.625 at p=0.01) during kharif 2012-13, regular sown condition.

Negative correlation of bright sunshine hours (r = -0.456**) was observed during kharif 2012-13, late sown condition. Morning relative humidity (r = 0.505**) and evening relative humidity (r = 0.426*) had statistically positive influence on blister beetle abundance. Strong association of evaporation in negative manner was also evident. During kharif 2012-13,

Table 3: Corelation of weather parameters and Blister beetles/MRL

Corelation of weather parametersand Blister beetles/MRL	2011-12 timely sown	2011-12 late sown	2012-13 timely sown
Maximum temperature (°C)	-0.389**	-0.175	-0.287
Minimum temperature (°C)	-0.386**	0.083	-0.625**
Bright sunshine hours (Hrs)	-0.270	-0.456**	-0.133
Wind speed (km/hr)	-0.047	-0.087	0.126
Relative humidity of morning (%)	-0.179	0.505**	0.208
Relative humidy of evening (%)	-0.021	0.426*	0.176
Evaporation (mm)	-0.075	-0.539**	-0.029
Rainfall (mm)	0.124	0.125	0.213
Rainy days	0.306*	0.179	0.045

Season 1A - 2011-12 Regular sown (n = 46) Simple linear correlation at 5%: 0.291(*) and at 1%: 0.376(**)
Season 1B - 2011-12 Late sown (n = 33) Simple linear correlation at 5%: 0.344(*) and at 1% : 0.443(**)
Season 2A - 2012-13 Regular sown (n = 25) Simple linear correlation at 5%: 0.398(*) and at 1% : 0.507(**)

Table 4: Behavioural study of adult blister beetles on greengram

Time frame	Total Blister beetles	Actively feeding	Per cent activity	Avoiding sunlight	Per cent activity	Facing sunlight	Per cent activity	Searching for food	Per cent activity	Idle position	Per cent activity
6:30 hrs. - 7:30 hrs.	5	5	100.0	0	0.0	5	100.0	0	0.0	0	0.0
7:30 hrs. - 8:30 hrs.	8	4	50.0	0	0.0	4	50.0	2	25.0	2	25.0
8:30 hrs. - 9:30 hrs.	6	6	100.0	0	0.0	6	100.0	0	0.0	0	0.0
9:30 hrs.- 10:30 hrs.	5	4	80.0	1	20.0	3	60.0	1	20.0	0	0.0
10:30 hrs. - 11:30 hrs.	4	3	75.0	2	50.0	1	25.0	1	25.0	0	0.0
11:30 hrs. - 12:30 hrs.	4	2	50.0	2	50.0	0	0.0	1	25.0	1	25.0
12:30 hrs. - 13:30 hrs.	3	1	33.3	1	33.3	0	0.0	1	33.3	1	33.3
13:30 hrs. - 14:30 hrs.	2	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
14:30 hrs. - 15:30 hrs.	3	1	33.3	1	33.3	0	0.0	0	0.0	2	66.7
15:30 hrs. - 16:30 hrs.	5	3	60.0	2	40.0	1	20.0	0	0.0	2	40.0
16:30 hrs. - 17:30 hrs.	6	4	66.7	1	16.7	3	50.0	1	16.7	1	16.7
17:30 hrs. - 18:30 hrs.	7	3	42.9	0	0.0	3	42.9	1	14.3	3	42.9
18:30 hrs. - 19:30 hrs.	8	0	0.0	0	0.0	0	0.0	0	0.0	8	100.0

regular sown condition, the number of rainy days (r = 0.306 at p = 0.01) and rainfall had positive correlation with seasonal abundance of the beetles, though the later being statistically non significant.

Data set indicate blister beetles on greengram prefer low temperature regime and lower bright sunshine hours and more rainy days, indicating positive influence of rainfall.

Ahad *et al*. (2011) reported that *M. pustulata* incidence was negatively correlated with maximum and minimum temperatures in maize. This finding is in correlation with present findings, though, the crop is different.

Behavioural study of adult blister beetles on greengram

The hourly observations were recorded during peak flowering period with highest pest activity. The observations were recorded from 6:30 hrs to 19:30 hrs at an interval of one hour. The data set can be broadly categorized in two major periods of activity. 06.30 hrs to 12.30 hrs, the pre noon period and 12.30 hrs to 19.30 hrs, the post noon period.

The actively feeding phase of blister beetles was recorded with a range of 50-100 per cent with majority involved in said activity. This percentage declined during post noon period with a actively feeding range of 33.3 to 66.7 per cent. Higher proportions of blister beetles oriented to sunlight from 06.30 hrs to 10.30hrs and later during 16.30 to 18.30 hrs. 11.30 hrs to 16.30 hrs most of the beetle population preferred to avoid the sunlight. Food searching activity was on higher side during the pre noon period, whereas, it decreased drastically during post noon period. Post feeding period majority of the beetles preferred state of idleness during post noon period.

At dusk blister beetles preferred to congregate at top of plants on bund like *Lantana camera, Acacia, Abelmoschus indicus* and wild okra. Blister beetles also gathered in huge number (30 - 40 beetles) on barbed wires and top of bamboo pegs. Similar observation were reported by Duraimurugan (2012) reported that, both the sexes of blister beetles aggregate in huge number (40 - 50 beetles) near the field of mating on barbed wires or on the trees of *Hibiscus rosasinensis* or *Mimosa* during dusk (5 - 7 pm.). He indicated possibility for presence of aggregation pheromone in *Mylabris pustulata* which results in the arrival of both sexes at calling site for mating. This report is in corroboration with the present findings.

Mahal *et al*. (1989) studied the behavioural activity of adult blister beetle, *Mylabris pustulata* (Thunb.). The dispersion of beetles was of an aggregated type. This was owing to their behavior and also heterogeneity in the crop. They concluded that adults were most active during the morning and evening, strengthening observations of present study. Other observations on feeding activity and orientation to sunlight could not be discussed for want of literature. It is evident from the data set that for short duration crop like greengram flowering phase of around 15 to 20 days should be targeted for the management of the adult blister beetles. The behavioural pattern of adult blister beetles also give a hint as to select early hours for the management of blister beetles as they leave the crop canopy and rest on higher positions like top of plants viz., *Lantana camera, Acacia sp., Abelmoschus indicus* etc.

ACKNOWLEDGEMENT

Authors are thankful to Dr. V. V. Ramamurthy, PI, NPIB, IARI, New Delhi, for identification of blister beetle specimens as *Mylabris phalerata* (Meloidae : Coleoptera).

REFERENCES

Ahad, I., Bhagat, R. M. and Md. Monobrullah 2011. Incidence and distribution of coleopteran insect pests on rainfed maize (*Zea mays* L.) in upper Himalaya of Jammu and Kashmir, India. *J. of Phytology*. **3**(**11):** 09-12.

Dhamdhere, S., Dhamdhere, S. V. and Mathur, R. 1995. Occurrence and succession of pests of brinjal, *Solanum melongena* Linn. at Gwalior (Madhya Pradesh), India. *J. Ent. Res.*, **19(1):** 71-77.

Dhavan, S. P., Pawar, K. S. and Wadaskar, R. M. 2013. Studies on greengram blister beetle, *Mylabris phalerata P*all. *Insect Environment*, **19(1):** 3 - 4.

Dhingra, S. and Sarup, P. 1992. Detection of resistance in the blister beetle, *Mylabris pustulata* Thunb. to various insecticides evaluated during the last quarter century. *J. Ent. Res*. **16(3):** 231 - 235.

Duraimurugan, P. 2012. Behaviour of adult *M. pustulata* and indication of aggregation pheromone. Pulses newsletter, Indian Institute of Pulses Research Unit, Kanpur. **23(4):** 5.

Durairaj, C. and Ganapathy, N. 1996. Identification of blister beetle complex on pigeonpea in Tamil Nadu, India. *Int. Chickpea and Pigeonpea Newsletter*. **3:** 96.

Garg, D. K. 1985. Blister beetle feeding on pigeonpea and other crops in Kumaon Hills of Uttar Pradesh. India. *Int. Pigeonpea Newsletter*. **4:** 54-55.

Mahal, M. S., Singh, R. and Singh, B. 1989. Behavioural studies on adults of blister beetle, *Mylabris pustulata* (Thunb.) and a plan for its sampling on Pigeonpea. *J. Res. Punjab Agric. Univ*. **26(2):** 237-240.

Patnaik, H. P., Mohapatra, H. K. and Senapati, B. 1993. Blister beetle incidence and some observations on its ovipositional behavior on pigeonpea in Orisa, India. *Int. Pigeonpea Newsletter*. **18:** 27-30.

Shende, Sarika, Thakare, A. Y. and Wadaskar, R. M. 2013. Dose mortality responces of blister beetles against some insecticides. *The Bioscan*. **8(3):** 1061-1064 (supplement on toxicology).