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Studies on yield loss by grape stem borer *Celosterna scabrator* Fabr. (Cerambycidae: Coleoptera)

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Abstract

Grape is ravaged by more than 100 insect pests among which stem borer *Celosterna scabrator* Fabr. (Cerambycidae: Coleoptera) is important and causes significant vine damage and yield loss. An attempt was made to study the yield losses and monetary losses caused by the pest during 2015-16 and 2016-17 in the vine orchards of Vijayapura district (Karnataka: India). Significant difference was recorded between the yield from healthy vines and stem borer affected vines. Pooled statistical analysis of yield data from two seasons of study revealed a significant difference between the yields from healthy vines and borer affected vines. ($Z=41.55$). Total yield of 425.45 kg/50 vines was recorded from healthy vines whereas stem borer affected vines recorded 186.08 kg. Studies also revealed mean yield loss of 5.05kg/vine, total yield loss of 239.35Kg/50 vines and 3475.75kg/ acre from borer affected vines. Monetary losses occurred to the tune of Rs 101.00/vine, 4787.00/50 vines and 69515.00 /acre.

Keywords: Grape, stem borer, yield loss, monetary loss

1. Introduction

Grape (*Vitis vinifera* L.) is one of the most important fruit crops of temperate zone which has acclimatized to tropical and sub-tropical agro climatic conditions prevailing in Indian sub-continent. Grape is originated in Western Asia and Europe. It is fairly a good source of minerals like calcium, phosphorous, iron and vitamins like B₁ and B₂. Grapes can be eaten as fresh or used for making jam, juice, jelly, vinegar, wine, grape seed extracts and grape seed oil. It is extensively grown in France, Italy, America, Africa, Australia, Algeria and India. India is the 13th largest producer of grapes appropriating 2.00 per cent of the global production. In India, grapes are cultivated in an area of 118.74 thousand hectares with a total production of 2,585.35 thousand MT and productivity of 21.77 tons/ha. Because of special arbour training systems provided for grape cultivation in India, productivity is highest among the grape growing countries of the world. The major grape growing states in India are Maharashtra (75.79%), Karnataka (17.23%), Tamil Nadu (2.39%), Telangana (1.036%), Mizoram (2.06%), Andhra Pradesh (0.36%) and Punjab (0.35%) and amounting to nearly 90 per cent of the total production.

Karnataka is the second largest grape growing state in India after Maharashtra, with an area of 20.46 thousand ha with a production of 302.39 thousand MT and productivity of 14.78 tones/ha^[1]. Grape is grown in two agro climatic zones of the state, namely north interior Karnataka and south interior Karnataka. North interior Karnataka comprises Vijayapura, Bagalkot, Belgaum, Koppal, Bidar and Gulbarga districts. In 2015-16, Vijayapura district contributed an area of 10562 ha, production of 211640 tons, with average productivity 20 tons/ha.

Grape being a perennial crop ravaged by various guilds of insect pests throughout the year. More than 100 pests are known to attack grapes in India (Mani *et al.*, 2014)^[2]. Stem borer of grape *Celosterna scabrator* Fabr. (Cerambycidae: Coleoptera) is a serious pest and becoming one of the limiting factors in grape cultivation and attaining a major pest status in the recent past in grape growing areas of northern Karnataka particularly in Vijayapur District^[3], and in grape growing areas of Rangareddy, Nalgonda and Medak districts of Andhra Pradesh^[4].

Female adults lay eggs below loose bark of stem and inside the old tunnels. Both adults and grubs cause damage to grape. Adult beetles gnaw the shoots of girth size between 1.4 to 2 cm leading to drying from the injury point where as, shoots with girth size more than 2 cm tolerated the injury and recouped^[3]. Grubs bore into the main stem, branches and roots.

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Initially reddish sap oozes from the wound and chewed material of wood and excreta are seen below the damaged plants. Sap translocation is affected and borer affected vines get weakened and growth of the vines is reduced leading to decrease in yield due to yellowing of leaves, shedding of leaves and dying and dieback of branches. The maturity of berries is also delayed which ultimately affects the grape production in terms of both yield and quality. If timely management practices are not taken, the pest incidence may result in the death of grape vines. Realizing the importance of pest, detailed study on yield loss and monetary losses caused by the stem borer was undertaken during 2015-16 and 2016-17 in Vijayapura district of Karnataka state.

2. Material and Methods

Studies on yield loss and monetary loss by grape stem borer *Celosterna scabrator* were conducted in grape orchards of Vijayapura during 2015-16 and 2016-17 which were under unprotected conditions and protected irrigation through drip system of irrigation. The variety under study was Thompson seedless with spacing of 6x10 feet. Observations were recorded from July first week to harvest of fruits in May at weekly interval on stem borer incidence and observations were recorded as the number of live tunnels/week. Vines with live tunnels till the harvest of fruits were considered as borer affected vines for recording yield along with healthy vines. Yield data was recorded from 50 healthy vines and 50 borer affected vines and finally yield per acre was calculated. Monetary losses were calculated by considering the market price of grape fruits as Rs 20/kg and finally losses incurred due to stem borer incidence was worked out.

3. Results and Discussion

3.1. Yield of grape fruits from healthy grape vines and stem borer affected grape vines during 2015-16 and 2016-17

The total yield recorded from 50 healthy vines, 50 borer affected vines, mean yield/ healthy vine and stem borer affected vine during both the years of study and pooled yield data of two years is presented in Table 1. Z test was done to compare the yields from healthy vines and stem borer affected vines. During 2015-16 mean yield of 9.21kg and 3.88 kg/vine was recorded from healthy vine and stem borer affected vine respectively. Total yield of 433.30 kg/50 vines was recorded from healthy vines whereas borer affected vines yielded 182.35kg. When yield data was compared by Z test, significant difference was found between the yields from healthy vines and stem borer affected vines ($Z(0.05)=28.620$). Similar trend was observed during the second season of study also. Healthy vine recorded a mean yield of 8.88 kg, whereas borer affected vine recorded a mean yield of 4.04 kg. Total yield of 417.60/50 vines recorded from healthy vines as against 189.80 kg from borer affected vines. Yield from

healthy vines and borer affected vines showed a significant difference with statistical Z value of 28.40. Pooled statistical analysis for yield data from two seasons of study revealed a significant difference between the yields from healthy vines and borer affected vines. ($Z(0.05)=41.55$). Total yield of 425.45 kg/50 vines was recorded from healthy vines whereas stem borer affected vines recorded 186.08 kg.

3.2. Yield losses and monetary losses caused by stem borer *Celosterna scabrator* Fabr. (Cerambycidae: Coleoptera)

Data on yield losses and monetary losses caused by *C. scabrator* is presented in Table 2. Mean yield loss of 5.05kg/vine, total yield loss of 239.35Kg/50 vines and 3475.75kg/ acre was recorded from borer affected vines. Monetary losses occurred to the tune of Rs 101.00/vine, 4787.00/50 vines and 69515.00 /acre.

Yield losses can be attributed to the extensive damage caused by the grubs of stem borer. Grubs feed on the internal contents of grape vine by tunneling in all directions on trunk, cordons and roots which affects the translocation of nutrients which results in yellowing of leaves, reduction in photosynthetic area of leaves, drying and withering of leaves. Because of this the vines become weak, fail to bear bunches or may bear very few bunches of smaller size which results in drastic reduction in yield of fruits. Present investigations are in agreement with the reports of [5-8]. Borer affected vines get weakened and growth of the vines is reduced leading to decrease in yield due to yellowing of leaves, shedding of leaves and dying and dieback of branches [5]. Stem borer causes 18-46.50% grape vine damage [6]. The stem borer damaged vines get weakened and growth gets affected. The maturity of berries is also delayed which ultimately affects the grape production in terms of both yield and quality [7]. Borer damaged vines get weakened and growth gets affected. The maturity of berries is also delayed, which ultimately affects the grape production in terms of both yield and quality [8]. Reports are also available on the incidence of cerambycid stem borers on tropical fruit crops. Mango stem borer (*Batocera rufomaculata* Dejan) grub enters in the shoot and creates tunnel inside the stem and damages the stem resulting in drying of shoots. Severe infestation affects the whole shoot and tree looks like burnt and the pest causes heavy reduction in yield [9]. Grubs of mango stem borer *B. Rufomaculata* feed inside the stem boring upward making irregular tunnels which results in interruption of nutrient and water transport in the tissue. Drying of terminal shoot in early stages and severe symptoms causes wilting of branches or entire tree in mango [10]. The grub of citrus trunk borer *Anoplophora versteegi* Rits. (Coleoptera: Cerambycidae) destroys the xylem and phloem during their long development period, causing the deterioration or death of the tree and resulting in serious economic losses in citrus [11].

Table 1: Comparison of yield data between healthy grape vines and stem borer affected vines

Vine	Yield (Kg/vine)	Yield (Kg/vine)	Yield (Kg/vine)	Yield (Kg/vine)	Pooled Healthy	Pooled Infested
	Healthy Vines	Borer affected Vines	Healthy Vines	Borer affected Vines		
	2015-16		2016-17		Pooled	
1	8.20	3.00	10.00	4.00	9.10	3.50
2	8.80	3.50	10.30	4.50	9.55	4.00
3	9.20	4.00	10.00	5.00	9.60	4.50
4	9.70	4.50	9.70	4.50	9.70	4.50
5	9.80	4.80	9.40	4.75	9.60	4.77
6	7.90	5.00	8.00	2.80	7.95	3.90
7	10.00	5.30	8.00	3.30	9.00	4.30

8	10.30	3.80	7.80	4.75	9.05	4.27
9	10.00	3.30	8.00	3.00	9.00	3.15
10	9.70	2.50	7.80	3.50	8.75	3.00
11	9.40	2.00	10.00	4.00	9.70	3.00
12	8.00	5.50	10.30	4.50	9.15	5.00
13	8.00	5.75	10.00	4.80	9.00	5.28
14	7.80	3.00	9.70	3.00	8.75	3.00
15	10.00	3.10	9.40	3.50	9.70	3.30
16	10.30	5.20	8.00	4.00	9.15	4.60
17	10.00	4.00	8.00	4.50	9.00	4.25
18	9.70	3.20	7.80	4.80	8.75	4.00
19	9.40	3.00	10.30	4.00	9.85	3.50
20	8.00	3.20	10.00	4.50	9.00	3.85
21	8.00	3.30	9.70	4.80	8.85	4.05
22	7.80	4.50	9.40	3.00	8.60	3.75
23	9.50	4.10	8.00	3.50	8.75	3.80
24	8.00	4.75	8.00	4.00	8.00	4.40
25	8.00	4.00	7.80	4.50	7.90	4.25
26	7.80	3.75	10.00	4.80	8.90	4.27
27	10.00	4.30	10.30	4.00	10.15	4.15
28	10.30	3.40	10.00	4.50	10.15	3.95
29	10.00	3.00	9.70	4.80	9.85	3.90
30	9.70	3.80	9.40	3.00	9.55	3.40
31	9.40	3.60	8.00	3.50	8.70	3.55
32	8.00	3.40	8.00	4.00	8.00	3.70
33	8.00	3.00	7.80	4.50	7.90	3.75
34	7.80	3.80	9.40	4.80	8.60	4.30
35	9.40	3.60	8.00	3.50	8.70	3.55
36	8.90	4.00	8.00	4.00	8.45	4.00
37	10.00	4.20	7.80	4.50	8.90	4.35
38	10.20	4.50	10.00	4.80	10.10	4.65
39	10.00	4.00	10.30	3.00	10.15	3.50
40	10.00	3.25	10.00	3.50	10.00	3.40
41	10.30	3.25	9.70	4.00	10.00	3.62
42	10.00	4.00	9.40	4.50	9.70	4.25
43	9.70	4.30	8.00	4.80	8.85	4.55
44	9.40	3.40	8.00	3.50	8.70	3.45
45	8.00	3.00	7.80	4.00	7.90	3.50
46	8.00	3.80	9.70	4.50	8.85	4.15
47	7.80	3.60	9.40	4.80	8.60	4.20
48	10.90	4.00	8.00	3.00	9.45	3.50
49	10.00	4.20	8.00	3.50	9.00	3.85
50	10.40	5.40	7.80	4.00	9.10	4.70
Total	433.30	182.35	417.60	189.80	425.45	186.075
Mean	9.219	3.879	8.885	4.038	9.052	3.959
Test Statistic Z Value(0.05)	28.620		28.400		41.55	
Table Z Value	1.9599		1.9599		1.9599	

Table 2: Yield and monetary losses as affected by *C.scabrator* incidence in grape

	Healthy Vines	Borer affected Vines	Incremental yield from healthy vines	Monitory losses due to stem borer incidence(Rs)
Mean yield/vine	9.05	4.00	5.05	101.00
Total yield/50 vines	425.45	186.10	239.35	4787.00
Yield /acre	6177.53	2701.80	3475.75	69,515.00

Price of marketable grape fruits= Rs 20.00/kg

4. Conclusion

The stem borer of grape *Celosterna scabrator* Fabr (Cerambycidae: Coleoptera) is attaining major pest status. Prophylactic measures through monitoring the emergence of adults, collection and destruction of adults and timely management of grubs minimizes the damage. Otherwise the pest incidence leads to significant yield and monetary losses and under severe conditions the death of vines.

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