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Original Research Article

Reaction of Local Land Races and Popular Cultivars of Finger Millet [*Eleusine coracana* (L.) Gaertn.,] against Earhead Caterpillars

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A B S T R A C T

A field experiment was conducted at randomized completely block design (RCBD) replicated thrice at the "G" block, Zonal Agricultural Research Station, Vishweshwaraiah Canal Farm, Mandya. A set of 32 genotypes under local landraces were selected and sown in three lines of 3-meter row with a spacing of 30 × 10 cm between rows and plants respectively against screening of different earhead caterpillars of finger millet *viz.*, *Archips micaceana*, *Somena scintillans*, *Cryptoblabes angustipennella*, *Nola analis*, *Cydia* sp., *Helicoverpa armigera*, *Pyrausta phoenicealis*, *Corcyra cephalonica*, *Stathmopoda* sp. and *Spodoptera frugiperda*. Results revealed that, out of 32 local land races, none of the genotypes were found under highly resistant category, whereas, two genotypes Hulubele (0.31 larvae/earhead) and Purna (0.31 larvae/earhead) found resistant and 15 genotypes reacted as moderately resistant (0.35 to 0.38 larvae/earhead), 11 genotypes found susceptible (1.11 to 1.18 larvae/earhead) and 4 genotypes considered as highly susceptible (1.78 to 1.99 larvae/earhead). During different stages of earhead, there was no incidence of earhead caterpillars during flowering stage, steady increase in the level of incidence was noticed at milky stage and gradually increased to reach their peak during dough stage, and further during maturity stage, the population became drastically reduced.

Keywords

Finger millet, Earhead caterpillars and local land races

Introduction

Finger millet, *Eleusine coracana* (L.) Gaertn is important climate resilient small millet, forms staple nourishment for many African and Asian countries of the world including India, wherever it is cultivated. It is also known as bird's foot, mandua, maruva, madua, nagli and nachni in different regions of the country and as "ragi" in south India and African millet and red millet in English (Rachie and Peters, 1977) belongs to family 'Poaceae'. *Eleusine*, the generic name, which is a Greek word meaning 'Goddess of Cereals" (Chalam and Venkateshwaralu 1965), The earliest archeological proof of its cultivation is from Ethiopia, circa 3000 B.C. Finger millet arose in Uganda and neighboring parts of Africa thousands of years ago and spread over to India by 1000 B.C (National Research Council 1996).

Earlier to the introduction of maize, ragi was the staple food crop in South Africa, and it is still a significant food crop in southern India. It ranks fourth among the millets in the world

(Hulse *et al.,* 1980) after sorghum, pearl millet and foxtail millet. This crop is widely cultivated in Asia and Africa, especially in India, Srilanka, Malaysia, China, Japan and most parts of central and east Africa both under rainfed and irrigated conditions. In India this crop is grown throughout the country for both grain and forage, more than half of the area and production are concentrated in southern India.

The major finger millet growing states are Karnataka, Uttarakhand, Tamil Nadu, Maharashtra, Odisha, Andhra Pradesh and Gujarat and cultivated over an area of 11.94 lakh ha with total production of about 19.85 lakh tonnes and with productivity of 1662 Kg ha^{-1} during the year 2017-18 (Anon, 2018). Karnataka is the major contributor nearly 65 % of finger millet both in area and production in the country and Tamil Nadu has the highest productivity (3714 Kg ha^{-1}), followed by Puducherry (2889 Kg ha^{-1}). This crop being cultivated in rainfed as well as irrigated situation. The crop is being grown throughout the year and up to 90 % of the area under rainfed condition particularly during *kharif* season.

The crop is being attacked by over 57 insect species (Sharma and Davies 1988) of which, shoot fly (*Atherigona miliaceae* Malloch), stem borer (*Sesamia inferens* Wlk.), white stem borer (*Saluria inficita* (Wlk.)), flea beetle (*Chaetocnema* sp), red headed hairy caterpillar (*Amsacta albistriga* Walk.), Bihar hairy caterpillar (*Spilarctia obliqua* Walk.), oriental armyworm (*Mythimna separata* Walk.), aphids, *Histeronura setariae*, ragi root aphid *Tetraneura nigriabdominalis* were considered as important.

During earhead stages mainly attacked by two hemipteran earhead bugs *viz.,* mirid bug (*Calocoris angstatus* Leth.) and rice bug, *Leptocorisa acuta* (Thunb), and several species of lepidopteran earhead caterpillars *viz*., *Cryptoblabes angustipennella* Hamps, *C. gnidiella* (Mill), *Eublemma (Autoba) silicula* Swinh, *Helicoverpa armigera* (Hub.), *Cacoecia epicyrta* Meur, *Stathmopoda theoris* Meyr, *Archips micaceanus* (Wlk.) and *Sitotroga cerealella* (Oliv.) are occasionally becomes serious (Anon., 2014). These, lepidopteran earhead caterpillars are becoming important insect species and major production constraints in all regions, especially southern parts of India (Krishnamurthi and Usman, 1952).

In southern parts of Karnataka, the farmers are facing serious problem of finger millet earhead caterpillars since from decades (Anon., 2018) especially in both *kharif* and *rabi* seasons regularly. In view of the growing need for the improvement in yield and due to the fact that finger millet earhead caterpillars are one of the major constraints for yield reduction, hence an attempt has been made to know the reaction of various local land races of finger millet to different species earhead caterpillar.

Materials and Methods

To assess the level of infestation of earhead caterpillar, a field experiment was laid out in Randomized Completely Block Design (RCBD) replicated thrice at the "G" block, Zonal Agricultural Research Station, Vishweshwaraiah Canal Farm, Mandya. A set of 32 genotypes under local landraces were selected and sown in three lines of 3-meter row with a spacing of 30 × 10 cm between rows and plants respectively. The recommended packages of practices were followed for rising of the crop from sowing to till harvesting. In each test genotype, the number of earhead caterpillars (species wise) was recorded on 10 randomly selected earhead at flowering, milky, dough and maturity stage and mean population was

worked out. Further, the data on the mean larval population and level of incidence was classified as follows.

Classification of finger millet genotypes

The means ($\bar{X}$) and standard deviation (σ) of larval population per earhead were recorded at flowering, milky, dough and maturity stages of earheads were pooled and mean larval population was computed on each genotype for grouping of resistance category. Further, classification/grouping of finger millet genotypes to genotypic resistance was assessed preliminarily by considering mean larval population per earhead as per Croxton and Cowden (1964).

Highly resistant

Genotypes with total larval mean population per earhead scale less than $\bar{X}$-2σ.

Resistant

Genotypes with total larval mean population per earhead scale range between $\bar{X}$-2σ to $\bar{X}$-σ.

Moderately resistant

Genotypes with total larval mean population per earhead scale range between $\bar{X}$-σ to $\bar{X}$.

Susceptible

Genotypes with total larval mean population per earhead scale range between $\bar{X}$ to $\bar{X}$+σ.

Highly susceptible

Genotypes with total larval mean population per earhead scale range between $\bar{X}$+σ to $\bar{X}$+2σ and above.

Further, observation were made on different caterpillar species *viz., A. micaceana, S. scintillans, C. angustipennella, N. analis, Cydia* sp., *H. armigera, P. phoenicealis, C. cephalonica, Stathmopoda* sp. and *S. frugiperda* on four fist type earhead genotypes at different stage of the crop *viz.*, flowering, milky, dough and maturity stage during *kharif* 2018 and 2019 to know severity status of earhead caterpillars at different stages of earhead. In each genotype, 20 earheads were selected randomly and observations on the number of earhead caterpillars infesting were recorded. The mean number of larval population was worked out species wise. The replicated data were subjected for ANOVA (Gomez and Gomez, 1984; Hosmand, 1988) and means were separated by Tukey's HSD (Tukey, 1965) for interpretation.

Results and Discussions

Among 32 local land races were evaluated against earhead caterpillars *viz., A. micaceana, S. scintillans, C. angustipennella, N. analis, Cydia* sp., *H. armigera, P. phoenicealis, C. cephalonica, Stathmopoda* sp. and *S. frugiperda* during *kharif* 2018 and 2019, the incidence of earhead caterpillar during flowering stage was nil. However, the total mean larval population at milky stage ($\bar{X}$= 1.11 ± 0.18) was varied between 0.34 to 1.65 larvae per earhead. Similarly, at dough and maturity stage of crop, the total mean larval population was ranged between 0.57 to 4.09 ($\bar{X}$= 1.40 ± 0.37) and 0.02 to 0.22 ($\bar{X}$= 0.75 ± 0.05) larvae/earhead, respectively, out of 32 local land races, none of the genotypes were found under highly resistant category, whereas, two genotypes, Hulubele (0.31 larvae/earhead) and Purna (0.31 larvae/earhead) found resistant and 15 genotypes reacted as moderately resistant (0.35 to 0.38 larvae/earhead), 11 genotypes found susceptible (1.11 to 1.18 larvae/earhead) and 4 genotypes considered as highly susceptible (1.78 to 1.99

larvae/earhead). Similar trend was noticed in both the years of the study. The details of genotypes with mean larval population under each entry, at different stages *viz.,* milky, dough and maturity of earhead presented in table 1 and genotypes under different categories of resistance presented in table 2.

These findings are in confirmation with the results of Paul *et al.,* (1980) who reported that, loose earhead entries *viz.,* N-13, SPV-210 and SPV-287 were found to be resistant. While compact earhead genotypes *viz.,* SPV-122 and SPV-369 exhibited highly susceptible reaction against *H. armigera* in sorghum. Similarly, Kulkarni (1976), Wilson (1976), Kundu and Sharma (1977), Anonymous (1982), Murthi and Harinarayana (1989), Mote and Murthy (1989), Gagre (1990), Kishore (1991), Kishore (1994), Bhadviya (1995), Sharma *et al.,* (1998), Patel (2011), Shivanand and Deshapande (2011), Raipuriya (2014), Dharmendra (2015), Patil *et al.,* (2018), Raveendra *et al.,* (2018), Patidar (2016), Patidar *et al.,* (2019) and Sharanabasappa (2004) in green gram, were recorded and reported similar observations.

Among test genotypes representing different earhead shape, four fist type genotypes were selected to study the occurrence of different earhead species complex of lepidopteron caterpillars during *kharif* 2018 and 2019. A significant level of incidence were observed based on mean larval population among different earhead stages at flowering, milky, dough and maturity stage of the of the crop. However, there was no incidence of earhead caterpillars during flowering stage. From flowering to milky stage a steady increase in the level of incidence was noticed and the population gradually increased to reach their peak during dough stage, and further during maturity stage, the population became drastically reduced as grain hardiness and opening of earheads begins (Figure 1).

At milky stage, total mean of four fist earheads shapes genotypes recorded 1.6 ± 0.05 and 1.7 ± 0.07 total mean larval populations per earhead during 2018 and 2019, respectively. An average of 1.7 ± 0.06 lepidopteron species complex was found per earhead. At dough stage, the incidence was almost doubled and as many as 3.7 ± 0.23 and 3.9 ± 0.28 larval populations per earhead was noticed during 2018 and 2019, respectively. An average of 3.8 ± 0.24 larve/earhead, (Figure 1). Further, there was a drastically decrease in the mean larval population at maturity stage *i.e.,* 0.20 ± 0.01 and 0.20 ± 0.02 during 2018 and 2019, respectively with a mean larval population of 0.20 ± 0.02. During maturity stage of the earhead, caterpillars harboured lesser incidence due to higher predatory activity and proved less sheltered for caterpillars as opening of ear shape and grain hardness occur. These results are in confirmation with the findings of Mital *et al.,* (1980) who reported that, the sorghum earhead caterpillar, *C. gnidiella* population was highest during dough stage of crop and declined with grain hardening and maturity. Similar studies were reported by, Ramadan *et al.,* (2004), Hosam and Gepaly (2019) and Hegde (1989)

It is concluded that among 32 local land races of finger millet evaluated, genotypes *viz.,* hulubele and purna found resistant to earhead caterpillar species and inferred that, breeders may endorse to go for these finger millet genotypes to combat the menace of earhead caterpillars species complex incidence in Cauvery command area. Further, maximum level of incidence was noticed at dough stage of earhead, moderate at milky, minimum at maturity stage and there was no incidence during flowering stage of four susceptible genotypes studied.

Table.1 Reaction of local land races fingermillet genotypes against incidence of earhead caterpillars at different stages of earhead, *kharif* 2018 and 2019

Sl. No	Genotypes	Mean number of larvae per earhead											
		Milky			Dough			Maturity			Mean		
		2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
1	Hulubele	0.30 (0.89)	0.38 (0.93)	0.34 (0.91)	0.53 (1.00)	0.61 (1.04)	0.57 (1.02)	0.01 (0.71)	0.02 (0.72)	0.02 (0.72)	0.28 (0.88)	0.34 (0.91)	0.31 (0.90)
2	Purna	0.33 (0.90)	0.37 (0.92)	0.35 (0.91)	0.53 (0.99)	0.62 (1.03)	0.58 (1.01)	0.01 (0.71)	0.02 (0.72)	0.02 (0.72)	0.29 (0.89)	0.34 (0.91)	0.31 (0.90)
3	B.K.Ragi	0.33 (0.89)	0.41 (0.93)	0.37 (0.91)	0.63 (1.02)	0.71 (1.05)	0.67 (1.03)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.32 (0.91)	0.37 (0.93)	0.35 (0.92)
4	HBP-76	0.39 (0.94)	0.46 (0.98)	0.43 (0.96)	0.73 (1.10)	0.74 (1.10)	0.74 (1.10)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.37 (0.93)	0.40 (0.95)	0.39 (0.94)
5	HR-374	0.36 (0.92)	0.44 (0.97)	0.40 (0.95)	0.63 (1.06)	0.60 (1.05)	0.62 (1.06)	0.02 (0.72)	0.01 (0.71)	0.02 (0.72)	0.34 (0.91)	0.35 (0.92)	0.34 (0.92)
6	HR-911	0.35 (0.92)	0.42 (0.95)	0.38 (0.94)	0.60 (1.04)	0.64 (1.06)	0.62 (1.05)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.32 (0.90)	0.35 (0.92)	0.34 (0.91)
7	Indaf-7	0.41 (0.94)	0.46 (0.96)	0.44 (0.95)	0.73 (1.09)	0.70 (1.07)	0.72 (1.08)	0.01 (0.71)	0.01 (0.71)	0.01 (0.71)	0.38 (0.94)	0.39 (0.94)	0.39 (0.94)
8	Indaf-8	0.44 (0.97)	0.51 (1.00)	0.47 (0.99)	0.63 (1.06)	0.70 (1.09)	0.67 (1.08)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.36 (0.93)	0.40 (0.95)	0.38 (0.94)
9	Indaf-9	0.42 (0.96)	0.47 (0.98)	0.45 (0.97)	0.73 (1.11)	0.75 (1.12)	0.74 (1.11)	0.02 (0.72)	0.01 (0.71)	0.02 (0.72)	0.39 (0.94)	0.41 (0.95)	0.40 (0.95)
10	Indaf-15	0.43 (0.96)	0.43 (0.96)	0.43 (0.96)	0.73 (1.10)	0.75 (1.11)	0.74 (1.11)	0.00 (0.71)	0.01 (0.71)	0.01 (0.71)	0.39 (0.94)	0.40 (0.95)	0.39 (0.94)
11	GPU-28	0.47 (0.98)	0.44 (0.97)	0.46 (0.98)	0.77 (1.12)	0.72 (1.10)	0.74 (1.11)	0.03 (0.73)	0.01 (0.71)	0.02 (0.72)	0.42 (0.92)	0.39 (0.94)	0.41 (0.95)
12	GPU-66	0.38 (0.93)	0.43 (0.96)	0.41 (0.94)	0.63 (1.05)	0.69 (1.07)	0.66 (1.06)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.34 (0.91)	0.37 (0.93)	0.36 (0.92)
13	MR-1	0.38 (0.94)	0.50 (1.00)	0.44 (0.97)	0.60 (1.05)	0.72 (1.11)	0.66 (1.08)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.33 (0.91)	0.41 (0.95)	0.37 (0.93)
14	MR-2	0.37	0.43	0.40	0.60	0.68	0.64	0.00	0.01	0.01	0.32	0.37	0.35

		(0.93)	(0.96)	(0.94)	(1.04)	(1.08)	(1.06)	(0.71)	(0.71)	(0.71)	(0.91)	(0.93)	(0.92)
15	MR-6	0.38 (0.93)	0.47 (0.98)	0.42 (0.96)	0.67 (1.07)	0.74 (1.11)	0.71 (1.09)	0.01 (0.71)	0.02 (0.72)	0.02 (0.72)	0.35 (0.92)	0.41 (0.95)	0.38 (0.94)
16	KMR-301	0.41 (0.95)	0.45 (0.97)	0.43 (0.96)	0.67 (1.07)	0.72 (1.10)	0.70 (1.08)	0.00 (0.71)	0.02 (0.72)	0.01 (0.71)	0.36 (0.93)	0.40 (0.95)	0.38 (0.94)
17	KMR-340	0.42 (0.96)	0.47 (0.98)	0.45 (0.97)	0.63 (1.06)	0.72 (1.10)	0.68 (1.08)	0.02 (0.72)	0.01 (0.71)	0.02 (0.72)	0.36 (0.93)	0.40 (0.95)	0.38 (0.94)
18	Giddaragi	0.96 (1.21)	1.09 (1.26)	1.03 (1.23)	2.09 (1.61)	2.28 (1.67)	2.19 (1.64)	0.09 (0.76)	0.13 (0.79)	0.11 (0.78)	1.05 (1.24)	1.17 (1.29)	1.11 (1.27)
19	K.K.Ragi	0.86 (1.16)	0.91 (1.18)	0.89 (1.17)	2.02 (1.58)	2.21 (1.64)	2.12 (1.61)	0.07 (0.76)	0.09 (0.77)	0.08 (0.76)	0.98 (1.22)	1.07 (1.25)	1.03 (1.24)
20	Indaf-3	0.95 (1.20)	1.00 (1.22)	0.98 (1.21)	2.08 (1.60)	2.43 (1.71)	2.26 (1.66)	0.10 (0.77)	0.12 (0.79)	0.11 (0.78)	1.04 (1.24)	1.18 (1.30)	1.11 (1.27)
21	Indaf-5	1.01 (1.23)	1.08 (1.25)	1.05 (1.24)	2.29 (1.67)	2.49 (1.73)	2.39 (1.70)	0.09 (0.76)	0.13 (0.80)	0.11 (0.78)	1.13 (1.28)	1.23 (1.32)	1.18 (1.30)
22	PR-202	0.86 (1.16)	0.98 (1.21)	0.92 (1.19)	2.25 (1.66)	2.47 (1.72)	2.36 (1.69)	0.10 (0.77)	0.10 (0.77)	0.10 (0.77)	1.07 (1.25)	1.18 (1.30)	1.13 (1.28)
23	GPU-26	0.89 (1.17)	1.05 (1.23)	0.97 (1.20)	1.87 (1.54)	2.13 (1.62)	2.00 (1.58)	0.09 (0.76)	0.16 (0.81)	0.13 (0.79)	0.95 (1.20)	1.11 (1.27)	1.03 (1.24)
24	GPU-45	0.88 (1.17)	1.10 (1.26)	0.99 (1.21)	2.04 (1.59)	2.16 (1.63)	2.10 (1.61)	0.08 (0.76)	0.12 (0.78)	0.10 (0.77)	1.00 (1.22)	1.13 (1.28)	1.06 (1.25)
25	GPU-48	0.89 (1.18)	1.05 (1.24)	0.97 (1.21)	1.85 (1.53)	1.98 (1.58)	1.92 (1.55)	0.11 (0.78)	0.16 (0.81)	0.13 (0.79)	0.95 (1.20)	1.06 (1.25)	1.01 (1.23)
26	KMR-204	0.85 (1.16)	1.03 (1.23)	0.94 (1.20)	2.03 (1.59)	2.17 (1.63)	2.10 (1.61)	0.09 (0.76)	0.11 (0.78)	0.10 (0.77)	0.99 (1.22)	1.10 (1.27)	1.05 (1.24)
27	KMR-630	0.95 (1.20)	1.11 (1.26)	1.03 (1.23)	2.20 (1.64)	2.29 (1.67)	2.25 (1.65)	0.08 (0.76)	0.11 (0.78)	0.10 (0.77)	1.08 (1.26)	1.17 (1.29)	1.12 (1.27)
28	L-5	0.81 (1.14)	0.92 (1.19)	0.87 (1.17)	2.17 (1.63)	2.22 (1.65)	2.19 (1.64)	0.10 (0.77)	0.13 (0.79)	0.12 (0.78)	1.03 (1.24)	1.09 (1.26)	1.06 (1.25)
29	Hamsa	1.49 (1.41)	1.65 (1.47)	1.57 (1.44)	3.63 (2.03)	3.86 (2.08)	3.75 (2.06)	0.20 (0.84)	0.21 (0.84)	0.21 (0.84)	1.77 (1.51)	1.91 (1.55)	1.84 (1.53)
30	GPU-67	1.60 (1.45)	1.82 (1.52)	1.71 (1.49)	3.58 (2.02)	3.98 (2.12)	3.78 (2.07)	0.19 (0.82)	0.24 (0.86)	0.22 (0.84)	1.79 (1.51)	2.01 (1.59)	1.90 (1.55)

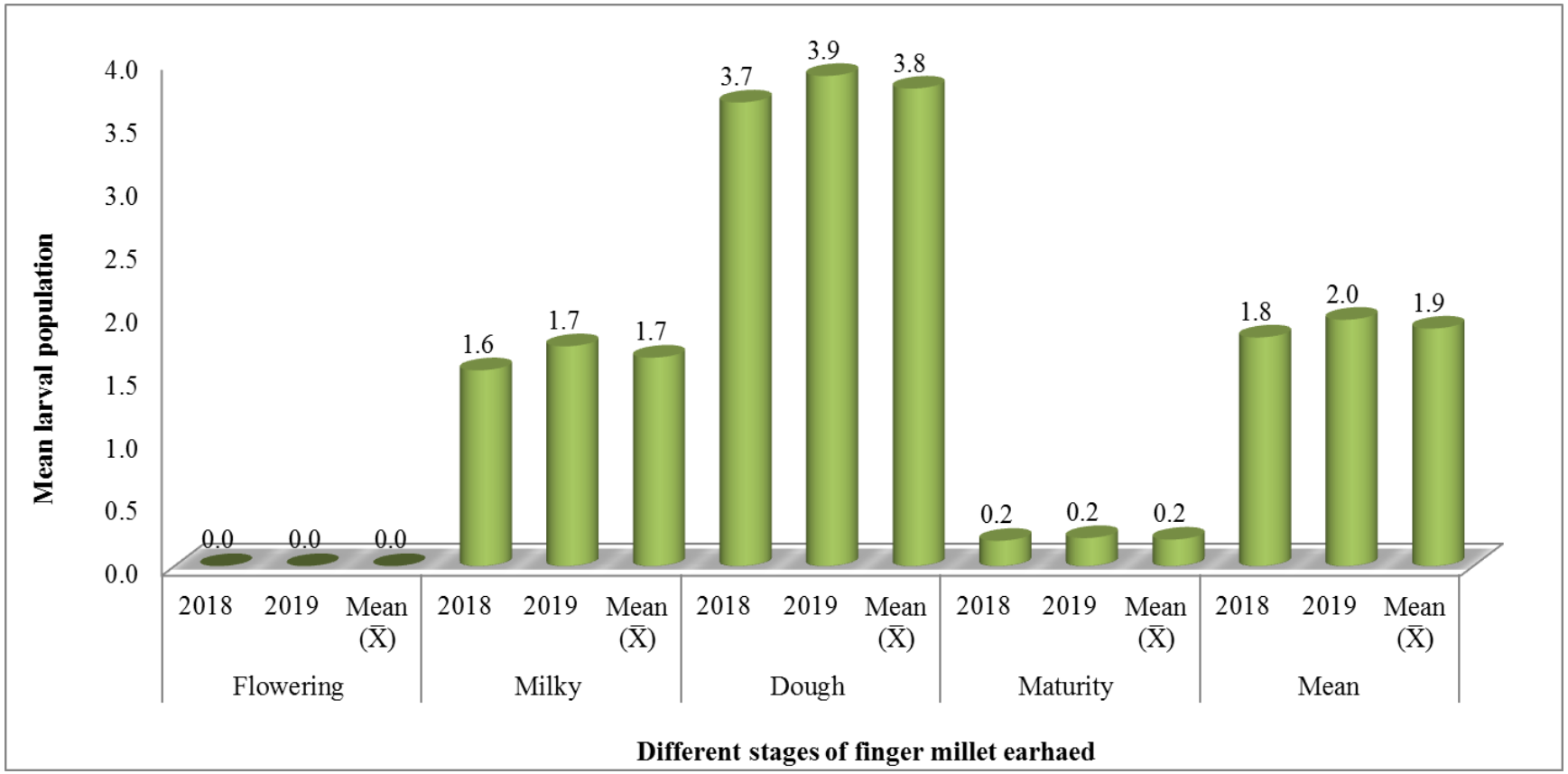
31	GE4449	1.53 (1.42)	1.76 (1.50)	1.65 (1.46)	3.48 (1.99)	3.51 (2.0)	3.50 (2.00)	0.19 (0.83)	0.20 (0.83)	0.20 (0.83)	1.73 (1.49)	1.82 (1.52)	1.78 (1.51)
32	Udurumallige	1.57 (1.44)	1.73 (1.49)	1.65 (1.46)	4.00 (2.12)	4.18 (2.16)	4.09 (2.14)	0.21 (0.83)	0.23 (0.85)	0.22 (0.85)	1.93 (1.56)	2.05 (1.60)	1.99 (1.58)
Mean ($\bar{X}$)		1.09	1.13	1.11	1.38	1.41	1.40	0.75	0.76	0.75	1.10	1.13	1.12
SD (σ)		0.18	0.19	0.18	0.36	0.37	0.37	0.04	0.05	0.05	0.22	0.23	0.22
SE m ±		0.03	0.03	0.03	0.06	0.07	0.06	0.01	0.01	0.01	0.04	0.04	0.04

*Figures in parentheses indicates √x+0.5 transformed values.

Table.2 Field reaction of genotypes under local land races to the incidence of earhead caterpillar, *kharif* 2018 and 2019

Scale range	Classification	Category	Number of genotypes	Genotypes
< 0.67	< $\bar{X}$-2σ	Highly resistant	-	-
0.67 - 0.90	$\bar{X}$-2σ to $\bar{X}$-σ	Resistant	2	Hulubele and Purna
0.90 - 1.12	$\bar{X}$-σ to $\bar{X}$	Moderately resistant	15	B.K.Ragi, HBP-76, HR-374, HR-911, Indaf-7, Indaf-8, Indaf-9, Indaf-15, GPU-28, GPU-66, MR-1, MR-2, MR-6, KMR-301 and KMR-340
1.12 - 1.34	$\bar{X}$ to $\bar{X}$+σ	Susceptible	11	Giddaragi, K.K. Ragi, Indaf-3, Indaf-5, PR-202, GPU-26, GPU-45, GPU-48, KMR-204, KMR-630 and L-5
1.34 - 1.56	$\bar{X}$+σ to $\bar{X}$+2σ	Highly susceptible	4	Hamsa, GPU-67, GE4449 and Udurumallige

Figure.1 Occurrence of different earhead caterpillar species on different stages of finger millet



*Observation recorded from four fist earhead finger millet genotypes under local landraces

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