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MORPHOMETRICS STUDY OF OKRA SHOOT AND FRUIT BORER, *EARIAS VITTELLA* (FABRICIUS)

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ABSTRACT

Study was carried out on Morphometrics of okra shoot and fruit borer, *Earias vittella* (Fabricius) on okra (GAO 5) at N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer 2022. Resulted that the average length and breadth of one day old eggs was 0.50 ± 0.02 and 0.47 ± 0.03 mm, respectively. Larvae passed through four instars. The average length of first, second, third and fourth instar larvae was 1.75 ± 0.19 , 2.48 ± 0.40 , 6.60 ± 0.32 and 13.91 ± 1.86 mm respectively, and average breadth was 0.28 ± 0.05 , 0.39 ± 0.07 , 1.16 ± 0.04 and 3.12 ± 0.52 mm, respectively. The pupa was boat shaped cocoon and light brown to dark brown in colour. The average length and breadth of pupa measured as 11.22 ± 0.97 and 4.38 ± 0.48 mm, respectively. Adults were soft bodied, pale white in colour with green longitudinal wedged shaped bend in the middle of forewings while, hind wings were pale white in colour. The last abdominal segment of male was roundish, while in case of female it was pointed having tuft of hair. The average length of male and female measured as 9.98 ± 0.59 and 11.41 ± 0.84 mm respectively, while average breadth with wingspan of male and female measured as 21.56 ± 0.86 and 22.20 ± 0.80 mm, respectively.

Key words : *Earias vittella* (Fabricius), Morphometrics, Okra, Shoot and fruit borer, Spiny bollworm, Spotted bollworm.

Introduction

Okra, *Abelmoschus esculentus* (L.) Moench is one of the most important vegetable crops has its own importance, on account of its taste, flavour and nutritional values as human food grown in tropical and sub-tropical parts of the world. Gujarat, Maharashtra, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Karnataka, Haryana and Punjab are the most prominent okra growing states in India, where it is grown as a kharif and summer season crop. It is grown on 5.44 lakh hectares in India, with an annual production of 64.94 lakh tonnes and a productivity of 11.93 tonnes per hectare (Anonymous, 2021). According to Dhamdhare *et al.* (1984), the crop is attacked by several species of insect pests causing considerable damage. All the plant stages are susceptible to insect pests and more than seventy two species of insect pests have been recorded on okra crop (Naik *et*

al., 2012).

Incidence of insect pests is one of the prime factors in lower production of okra. The major insect pests infesting okra are shoot and fruit borer (*Earias vittella* Fabricius and *Earias insulana* Boisduval), jassid (*Amrasca bigutulla bigutulla* Ishida), aphid (*Aphis gossypii* Glover), thrips (*Thrips tabaci* Lindeman, *Scirtothrips dorsalis* Hood), whitefly (*Bemisia tabaci* Gennadius), fruit borer (*Helicoverpa armigera* (Hubner) Hardwick), semi looper (*Anomis flava* Fabricius), mealybug (*Ferrasia virgata* Cockrell), scale insect (*Saissetia coffeae* Walker) and red spider mite (*Tetranychus cinnabarinus* Boisduval).

Among various insect pests, shoot and fruit borer commonly known as spotted bollworm is the most destructive one, as it causes direct loss of okra fruits. Mainly two species *viz.*, *E. vittella* and *E. insulana* are

found to cause serious damage to the crop but *E. vittella* is the predominant species in Gujarat.

Earias vittella is an oligophagous pest and its main hosts are okra and cotton. It is also found feeding on a large number of cultivated and wild malvaceous plants species. The pest is active almost the year round and prefers high humidity and high temperature for its growth and development.

In India, an estimated loss of 69.00 per cent in marketable yield was due to attack of this insect on okra alone (Ray *et al.*, 2019). The study of biology of shoot and fruit borer is essential to know the life history and habit of this pest for finding out the most vulnerable stage during life span which helps in developing suitable management strategies.

Materials and Methods

The present investigation on Morphometrics study of okra shoot and fruit borer, *Earias vittella* (Fabricius) was conducted in PG laboratory, Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer 2022. The materials used and methodology adopted for the present investigations on the various aspects are as follows.

Laboratory Culture

To raise the initial culture of *E. vittella*, the infected fruits of okra along with larvae collected from the unsprayed okra cv. Gujarat Anand Okra 5 crop grown at college farm and would be taken to the laboratory. Infected fruits were kept in glass jar (20 cm x 14 cm). The top of the jar was covered with pieces of muslin cloth and held in position with the help of rubber band (Fig. 1). After the pupae were formed in such jars, they were sorted out for adult emergence. The newly emerged adult moths were released in the oviposition cage (20 cm diameter x 45 cm height) for mating (Fig. 2) and tender shoot and fruit were provided for oviposition. Tender shoot was changed daily and examined daily for eggs.

A cotton swab dipped in five per cent honey solution was given as food in small petridishes as a food for moths. A set of 50 eggs were taken for morphometrics study.

Egg

Freshly laid eggs were collected with the help of a fine camel hair brush and placed in separate in plastic bottle individually for studying their shape and size. Shape and size of eggs were determined with the help of Stereo Trinocular Microscope Olympus-SZ (16) fitted with brand catcam-130 camera having software power scopephoto for measuring the size of egg (Fig. 3). On hatching, larva

was provided with sufficient number of leaves and tender fruit of okra.

Larvae

To study the size of larvae the cut pieces of okra fruits were put in plastic culture tube and newly emerged larvae were transfer with help of fine camel hair brush. The piece of okra fruit in each plastic culture tube was changed daily in morning and the developing larva from the old piece was transferred to a fresh piece. All the larvae were kept under observation daily for their change of instars. A change of instar was confirmed by presence of casted head capsule and exuviae in the rearing plastic bottle. Observations for the size of the larvae were recorded for each instar. Length and breadth of larvae were measured under Stereo Trinocular Microscope (Fig. 4). Fresh food (green tender fruits) was provided daily and old food was removed from culture tube.

Pupa

To know the pupal measurement, the larva was observed from the time, when it stooped feeding and become sluggish to the time when it turns to pupa. The duration between formation of pupa to the emergence of



Fig. 1 : Damaged fruits of okra collected from field.



Fig. 2 : Oviposition cage.

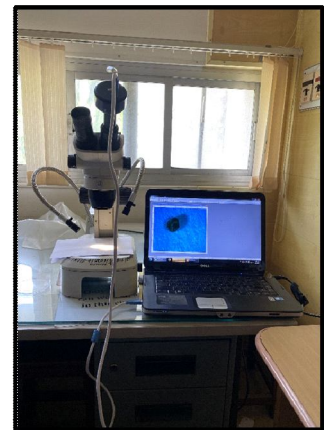


Fig. 3 : Measurement of eggs under stereo trinocular microscope.

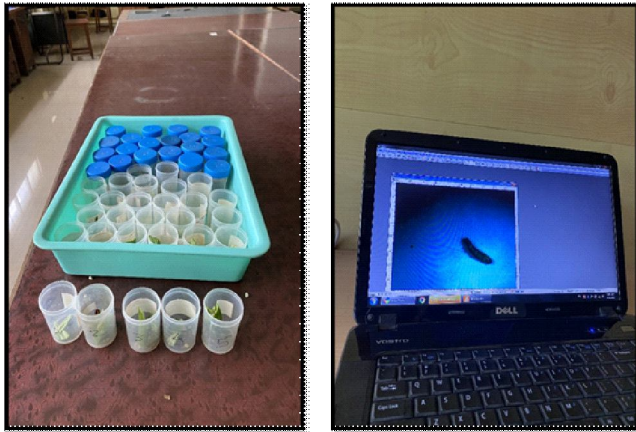


Fig. 4 : Rearing and measurement of *E. vittella* larvae.



Fig. 5 : Measurement of *E. vittella* adult.

adult was considered as pupal stage. Observation on length and breadth of pupa were measured with the help of measuring scale.

Adult

Adults emerged from pupae were observed under microscope for their shape and sex differences. Whereas, size was measured with help of measuring scale (Fig. 5). The female distinguished from the male by the presence of bunch of hair on the last abdominal segment. Also honey solution was given as food in small petridishes.

Results and Discussion

Studies on the Morphometrics study of *E. vittella* provide information regarding various stages and their behaviour which helpful in identifying the different stages and its potential in its life cycle for better pest management. Therefore, the present investigation on the morphometrics study of shoot and fruit borer were carried out on Gujarat Anand Okra 5 variety of okra in the laboratory condition ($26.9 \pm 1.35^{\circ}\text{C}$ temperature and $51.55 \pm 5.76\%$ relative humidity) at the Department of Entomology, N. M. College of Agriculture, Navsari

Agricultural University, Navsari during summer 2022. The results obtained during the present studied are presented and discussed here under.

Eggs

The data on measurement of length and breadth of the eggs presented in Table 1 revealed that the length of eggs varied from 0.46 to 0.59 mm with an average of 0.50 ± 0.02 mm. Similarly, the breadth of eggs was 0.40 to 0.55 mm with an average of 0.47 ± 0.03 mm. More or less similar observations in length and breadth of eggs was also recorded by Kathiriya *et al.* (2007) who reported that the length of eggs of *E. vittella* varied from 0.49 to 0.56 mm while, breadth varied from 0.49 to 0.56 mm when larvae were reared on okra fruits. Patel *et al.* (2010) measured that on an average 0.52 ± 0.02 mm in length and 0.51 ± 0.02 mm in breadth when reared on okra. Thus, the report of the above workers supports the present findings. The ridges present on eggs persisted until hatching took place. After the emergence of the larvae, the egg shell became transparent with a tiny emergence hole made by the larva.

Larvae

In order to study the various larval instars of *E. vittella*, the larvae were reared on okra fruits till they were pupated. The data obtained on various biological parameters of different larval instars are presented in Table 1.

Number of larval instars

During the present studies, *E. vittella* observed to pass through four larval instars. Similarly, in past, Kathiriya *et al.* (2007), Patel *et al.* (2010), Dongarjal and Bhamare (2016) and Sahito *et al.* (2019) were reported four larval instars of *E. vittella*. While, Rajveer *et al.* (2016) observed five larval instars.

First instar : It was seen from Table 1 that the length of the first instar larva ranged from 1.36 to 2.18 mm with an average of 1.75 ± 0.19 mm, while breadth varied from 0.19 to 0.41 mm with an average of 0.28 ± 0.05 mm. The report is almost similar to that average length and breadth of first instar larva was 1.61 ± 0.26 mm and 0.33 ± 0.04 mm, respectively reported by Kathiriya *et al.* (2007). Patel *et al.* (2010) also observed that the average 1.75 ± 0.29 mm length and 0.26 ± 0.04 mm breadth.

Second instar : The length of the second instar larva ranged from 1.82 to 3.05 mm (2.48 ± 0.40 mm) and 0.26 to 0.49 mm (0.39 ± 0.07 mm) in breadth (Table 1). This finding is supported by Kathiriya *et al.* (2007) who reported that the average length of 2.33 ± 0.39 mm and

Table 1 : Measurement of different immature stages of okra shoot and fruit borer, *E. vittella*.

S. no.	Eggs		First instar larva		Second instar larva		Third instar larva		Fourth instar larva		Pupa	
	Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)
1	0.53	0.48	1.50	0.19	1.96	0.27	6.18	1.12	11.70	2.60	12.80	5.84
2	0.54	0.52	1.61	0.21	2.18	0.35	6.49	1.12	12.85	3.20	10.88	4.28
3	0.59	0.55	1.55	0.20	3.02	0.47	6.89	1.18	10.70	2.42	11.48	4.09
4	0.52	0.49	1.49	0.21	1.82	0.26	6.78	1.17	15.20	3.50	12.32	4.18
5	0.52	0.50	1.52	0.23	1.92	0.28	5.98	1.08	17.25	4.19	10.90	4.28
6	0.52	0.44	1.80	0.27	2.48	0.39	5.94	1.08	16.80	4.10	11.51	4.75
7	0.50	0.48	1.39	0.20	2.12	0.37	7.01	1.23	13.40	3.10	11.77	4.27
8	0.50	0.48	2.01	0.32	1.90	0.32	5.90	1.07	15.80	3.70	11.80	3.80
9	0.51	0.46	2.11	0.34	2.35	0.38	6.70	1.15	11.45	2.50	12.00	4.25
10	0.52	0.48	1.95	0.33	2.70	0.42	6.81	1.18	14.80	3.10	12.40	4.30
11	0.48	0.51	1.83	0.31	1.98	0.32	6.78	1.17	13.20	2.90	11.70	5.00
12	0.48	0.43	1.78	0.29	2.18	0.34	6.51	1.13	14.70	3.11	10.48	3.70
13	0.49	0.48	1.70	0.28	1.85	0.31	6.21	1.12	12.95	3.21	11.33	5.43
14	0.52	0.51	1.67	0.26	3.02	0.48	6.98	1.21	13.80	3.40	11.30	4.30
15	0.48	0.43	1.78	0.31	2.70	0.43	7.10	1.27	12.70	3.15	11.05	4.70
16	0.50	0.43	1.83	0.34	3.05	0.48	6.56	1.15	12.85	3.20	10.80	3.46
17	0.51	0.50	1.87	0.36	2.87	0.42	5.98	1.09	10.95	2.44	10.60	4.80
18	0.50	0.48	1.71	0.24	2.61	0.40	6.76	1.17	11.50	2.50	10.90	4.13
19	0.48	0.44	1.60	0.22	2.51	0.38	6.85	1.19	12.80	3.25	10.73	5.30
20	0.51	0.46	1.67	0.30	2.75	0.39	6.78	1.18	15.40	3.10	11.11	4.75
21	0.46	0.41	1.72	0.33	2.03	0.32	6.94	1.19	15.75	3.20	12.00	4.17
22	0.50	0.48	1.78	0.35	1.89	0.30	6.90	1.19	14.85	3.05	12.00	4.70
23	0.51	0.51	1.86	0.34	2.49	0.42	6.67	1.16	13.85	2.90	12.18	4.51
24	0.56	0.42	1.56	0.20	2.58	0.44	6.53	1.16	14.90	3.10	11.70	5.80
25	0.49	0.47	1.92	0.33	2.87	0.46	6.42	1.14	15.80	3.20	11.05	4.25
26	0.53	0.48	1.88	0.32	2.98	0.46	6.34	1.14	13.45	2.80	12.01	4.27
27	0.48	0.43	1.83	0.30	2.44	0.41	6.39	1.15	13.75	2.90	10.67	3.80
28	0.49	0.44	1.79	0.29	2.43	0.42	6.21	1.13	12.80	2.50	11.01	4.03
29	0.51	0.44	1.75	0.28	1.98	0.32	6.78	1.18	13.45	2.80	10.90	4.40
30	0.54	0.51	1.68	0.24	2.12	0.34	6.89	1.20	11.85	2.55	10.13	4.46
31	0.50	0.46	1.48	0.20	3.01	0.47	7.10	1.26	10.70	2.46	11.18	4.08
32	0.50	0.46	1.76	0.24	2.89	0.45	6.21	1.14	13.40	2.70	12.40	4.60
33	0.48	0.45	1.85	0.28	2.76	0.43	6.90	1.18	15.85	3.80	12.70	4.13
34	0.49	0.47	1.81	0.27	2.87	0.43	6.87	1.17	14.80	3.15	10.99	4.01
35	0.47	0.43	1.72	0.24	2.69	0.42	6.56	1.15	17.20	4.20	10.90	3.92
36	0.48	0.45	1.96	0.38	2.78	0.44	6.65	1.15	16.80	4.10	12.79	4.15
37	0.47	0.45	1.83	0.29	1.99	0.30	6.75	1.16	16.75	4.10	12.00	4.44
38	0.50	0.47	2.18	0.41	2.49	0.41	6.69	1.16	13.70	2.75	12.70	4.66
39	0.51	0.50	1.36	0.22	2.68	0.44	6.83	1.18	12.85	3.20	9.63	4.10
40	0.55	0.46	1.42	0.23	2.75	0.46	6.24	1.13	14.90	3.15	10.06	4.00
41	0.48	0.45	1.74	0.28	2.63	0.44	6.42	1.14	15.00	3.20	9.75	3.95
42	0.49	0.45	1.87	0.27	1.87	0.28	7.04	1.24	17.05	4.15	10.72	4.20

Table 1 continued...

Table 1 continued...

43	0.51	0.48	1.91	0.30	1.99	0.29	6.89	1.20	12.20	2.75	9.57	4.83
44	0.53	0.50	1.60	0.26	2.01	0.31	6.70	1.15	10.65	2.45	9.00	4.33
45	0.50	0.44	1.73	0.27	2.49	0.33	6.49	1.14	11.70	2.55	11.34	4.03
46	0.51	0.48	1.41	0.21	2.70	0.45	6.34	1.13	12.55	2.95	9.50	4.65
47	0.49	0.47	1.89	0.31	2.99	0.47	6.70	1.16	13.45	2.75	13.00	3.87
48	0.50	0.47	2.15	0.38	3.01	0.49	6.89	1.18	16.50	4.00	10.86	4.60
49	0.52	0.48	1.77	0.27	2.70	0.46	6.24	1.12	13.50	2.80	11.40	4.52
50	0.53	0.50	1.84	0.28	2.78	0.46	6.49	1.15	14.80	3.20	9.40	4.10
Min.	0.46	0.40	1.36	0.19	1.82	0.26	5.90	1.07	10.65	2.42	9.00	3.46
Max.	0.59	0.55	2.18	0.41	3.05	0.49	7.10	1.27	17.25	4.20	13.00	5.84
Mean±	0.50 ±	0.47 ±	1.75 ±	0.28 ±	2.48 ±	0.39 ±	6.60 ±	1.16 ±	13.91 ±	3.12 ±	11.22 ±	4.38 ±
S.D.	0.02	0.03	0.19	0.05	0.40	0.07	0.32	0.04	1.86	0.52	0.97	0.48

Table 2. Morphometric of adults of *E. vittella*.

S. no.	Female		Male	
	Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)
1	10.95	20.80	10.10	22.25
2	11.20	22.10	9.85	22.10
3	11.55	22.40	9.70	21.90
4	11.70	23.10	10.20	19.90
5	9.50	22.60	9.50	19.95
6	11.60	22.15	10.80	22.25
7	11.20	21.80	10.85	22.40
8	11.80	21.60	10.50	22.50
9	11.85	23.30	10.65	20.55
10	12.00	22.35	9.85	20.75
11	12.40	22.65	9.10	20.60
12	10.50	22.75	9.40	21.80
13	11.30	21.85	9.60	21.40
14	11.45	20.50	10.70	21.00
15	9.35	23.60	10.45	20.90
16	12.40	22.20	9.30	21.85
17	12.60	21.90	9.90	21.95
18	11.80	23.25	10.15	22.05
19	11.85	21.40	10.30	22.50
20	11.25	21.75	8.70	22.55
Min.	9.35	20.50	8.70	19.90
Max.	12.60	23.60	10.85	22.55
Mean±	11.41±	22.20±	9.98±	21.56±
S.D.	0.84	0.80	0.59	0.86

breadth of 0.38 ± 0.07 mm. Patel *et al.* (2010) recorded average 2.62 ± 0.43 mm body length and 0.36 ± 0.07 mm breadth.

Third instar : The data on measurement presented in Table 1 indicated that the length of the third instar larva varied from 5.90 to 7.10 mm, while that of the breadth varied from 1.07 to 1.27 mm. The average length and breadth of third instar larva was 6.60 ± 0.32 and 1.16 ± 0.04 mm, respectively. These finding is similar to the finding of Kathiriya *et al.* (2007) who reported that the length and breadth varied from 5.80 to 7.20 mm (6.31 ± 0.41 mm) and 1.10 to 1.25 mm (1.17 ± 0.05 mm), respectively. Patel *et al.* (2010) recorded 6.35 ± 0.56 mm average body length and 1.17 ± 0.09 mm breadth.

Fourth instar : It can be seen from Table 1 that the length of the fourth instar larva varied from 10.65 to 17.25 mm (13.91 ± 1.86 mm), while the breadth varied from 2.42 to 4.20 mm (3.12 ± 0.52 mm). The report is almost similar to that of reported Kathiriya *et al.* (2007), who measured that the 13.80 ± 2.32 mm in length and 3.26 ± 0.53 mm in breadth. Patel *et al.* (2010) recorded the length varying from 10.35 to 16.85 mm and 2.40 to 4.00 mm breadth.

Pupa

The pupa measured about 9.00 to 13.00 mm in length with an average of 11.22 ± 0.97 mm and 3.46 to 5.84 mm in breadth with an average of 4.38 ± 0.48 mm (Table 1).

Kathiriya *et al.* (2007) reported that the length and breadth of pupa varied from 9.50 to 11.60 mm (10.39 ± 0.57 mm) and 3.00 to 3.70 mm (3.42 ± 0.19 mm), respectively. However, Rajveer *et al.* (2016) observed an average length 8.18 mm and 3.81 mm breadth. The difference in findings might be due to different rearing

Table 3. Measurement of different stages of *E. vittella*.

S. no.	Life stage	Particulars	Measurement (mm)		
			Minimum	Maximum	Mean \pm S.D.
1	Egg	Length	0.46	0.59	0.50 \pm 0.02
		Breadth	0.40	0.55	0.47 \pm 0.03
2	Larva				
	1 st instar	Length	1.36	2.18	1.75 \pm 0.19
		Breadth	0.19	0.41	0.28 \pm 0.05
	2 nd instar	Length	1.82	3.05	2.48 \pm 0.40
		Breadth	0.26	0.49	0.39 \pm 0.07
	3 rd instar	Length	5.90	7.10	6.60 \pm 0.32
		Breadth	1.07	1.27	1.16 \pm 0.04
	4 th instar	Length	10.65	17.25	13.91 \pm 1.86
		Breadth	2.42	4.20	3.12 \pm 0.52
3	Pupa	Length	9.00	13.00	11.22 \pm 0.97
		Breadth	3.46	5.84	4.38 \pm 0.48
4	Adult				
	Male	Length	8.70	10.85	9.98 \pm 0.59
		Breadth	19.90	22.55	21.56 \pm 0.86
	Female	Length	9.35	12.60	11.41 \pm 0.84
		Breadth	20.50	23.60	22.20 \pm 0.80

condition of particular location or different host insect nutrition.

Adult

The data on measurements of body length and breadth of female and male are presented in Table 2. The data revealed that the length of female varied from 9.35 to 12.60 mm with an average of 11.41 \pm 0.84 mm and breadth varied from 20.50 to 23.60 mm with an average of 22.20 \pm 0.80 mm. In case of male, the length varied from 8.70 to 10.85 mm (9.98 \pm 0.59 mm) and breadth varied from 19.90 to 22.55 mm (21.56 \pm 0.86 mm). Kathiriya *et al.* (2007) reported the length and breadth of adults which was ranged from 6.75 to 11.05 mm and 14.10 to 20.30 mm, respectively. Patel *et al.* (2010) reported the average length of female and male was 10.10 \pm 1.62 and 9.10 \pm 0.84 and width was 22.14 \pm 1.62 and 20.90 \pm 1.25 mm. Thus, the findings of the above workers support the present findings.

Conclusion

The length and breadth of one day old eggs was ranging from 0.46 to 0.59 mm (0.50 \pm 0.02 mm) and 0.40 to 0.55 mm (0.47 \pm 0.03 mm). The larvae passed through

four instars. The average length of first, second, third and fourth instar larvae was 1.75 \pm 0.19, 2.48 \pm 0.40, 6.60 \pm 0.32 and 13.91 \pm 1.86 mm respectively, while that the average breadth was 0.28 \pm 0.05, 0.39 \pm 0.07, 1.16 \pm 0.04 and 3.12 \pm 0.52 mm, respectively. The body was shrunken during the formation of pre-pupa. The average length and breadth of pupa measured as 11.22 \pm 0.97 and 4.38 \pm 0.48 mm, respectively. The average length of male and female measured as 9.98 \pm 0.59 and 11.41 \pm 0.84 mm, respectively. The average breadth with wingspan of male and female measured as 21.56 \pm 0.86 and 22.20 \pm 0.80 mm, respectively.

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