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Evaluation of efficacy of neonicotinoids against *Aphis Gossypii* Glover and *Amrasca Biguttula Biguttula* ishida infesting okra

MA Pawar, CS Patil and PN Guru

Abstract
Investigations were carried out to evaluate the efficacy imidacloprid to *Aphis gossypii* Glover and *Amrasca biguttula biguttula* Ishida under field condition during summer, 2012. The results revealed that imidacloprid 17.8 SL @ 30 g a.i./ha emerged as the most effective treatment against aphids and jassids with realized yield of 60.49 q/ha. It was at par with imidacloprid 70 WG @ 30 g a.i./ha with yield of 59.26q/ha. Next in order of effectiveness were imidacloprid 70 WG @ 25 g a.i./ha, imidacloprid 17.8 SL @ 25 g a.i./ha and thiamethoxam 25 WG @ 25 g a.i./ha.

Keywords: *Aphis gossypii*, *Amrasca biguttula biguttula*, neonicotinoids, field efficacy

Introduction
Okra is cultivated throughout India over an area of 5.30 lakh hectares with a total annual production of 63.50 lakh metric tonnes, (Anon., 2013) [2]. In Maharashtra bhendi is grown over 19000 ha with total annual production of 224 thousand metric tonnes providing continuous and good source of income to the farmers.

Growers of okra frequently complain yield losses due to insect pests. The important pests affecting the yield of okra are shoot and fruit borer (*Earias vittella* Fab), jassid (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover), whitefly (*Bemisia tabaci* Genn,) and mite (*Tetranychus* spp.). The attack of aphid (*Aphis gossypii* Glover) and jassid (*Amrasca biguttula biguttula* Ishida) right from early seedling stage to last fruit harvest. Presently broad range of systemic, contact, synthetic pyrethroids and biopesticides are recommended for the control of okra pests. However, short picking interval of okra fruits cause residue hazards to the consumers when conventional pesticides are used repeatedly, besides killing natural enemies and eventual development of resistance (Dethe and Kale, 1990).

Imidacloprid belonging to neonicotinoid group has been used in a big way against sucking pests. However other candidates belonging to this group are acetamiprid, thiamethoxam, clothianidin etc. Development of resistance in sucking pests to imidacloprid has already been documented in different crops (Honnappagouda *et al.*, 2011, Kevin *et al.*, 2008, Sethi and Dilawari, 2008 and Tabacian *et al.*, 2011) [11, 7, 17, 20] However, recently the farmers have started claiming the reduced efficacy of imidacloprid against aphids and jassids. Therefore, it is essential to evaluate the performance of these insecticides against *A. gossypii* and *A. biguttula biguttula*.

Material and Methods
Beds of ridges and furrows of 4m × 3m size were prepared and Arka anamika variety was used with two seeds were dibbled at one spot at 20-25 mm depth, following 30cm × 15cm spacing. After 7 days of sowing, thinning and gap filling was done to maintain uniform plant population. The crop was raised following all recommended package of practices except plant protection measures against aphids and jassids. Blanket application of recommended insecticide endosulfan 35 EC was given for the management of lepidopteran pests. Two foliar sprays of insecticides were given first after incident was noticed and 20 days thereafter. The spray solution was prepared by measuring required quantity of insecticides in water. Spraying was carried out by using knapsack sprayer. Care was taken to avoid drift to neighboring plots. Spraying was done in morning hours and care was taken to wash the pump with water while switching from one insecticide to another. First spray was given after the incidence was noticed.

Observations on adult aphids and jassid nymphs were recorded on five randomly selected plants per plot. Number of aphids and jassids were recorded from three leaves of each

randomly selected five plants i.e. top, middle and bottom. Observations were recorded just before first spraying and 1, 3, 5, 7, 10 and 15 days after spraying (DAS). The field population data were subjected to statistical analysis. (Panse and Sukhatme., 1967) [12].

Results and Discussion

Aphid, *A. Gossypii*

First spray

The data (Table 1) revealed that aphid population declined marginally from DBS to 1 DAS and then gradually increased from 3 DAS to 15 DAS.

Considering the mean population of aphids at different intervals after first spray, lowest population was observed in treatment of imidacloprid 17.8 SL @ 30 g a.i./ha (3.23 aphids per leaf). It was followed by imidacloprid 70 WG @ 30 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha, imidacloprid 70 WG @ 25 g a.i./ha and imidacloprid 17.8 SL @ 25 g a.i./ha, with 3.51, 4.83, 4.87 and 4.94 aphids per leaf, respectively. Highest population was recorded in the untreated plots (23.08 aphids per leaf).

Second spray

The data (Table 2) revealed that aphid population declined marginally from DBS to 1 DAS and then gradually increased from 3 DAS to 15 DAS.

Considering the mean population of aphids after second spray, lowest population was observed in treatment of imidacloprid 17.8 SL @ 30 g a.i./ha (3.12 aphids per leaf). It was followed by imidacloprid 70 WG @ 30 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha, imidacloprid 70 WG @ 25 g a.i./ha and imidacloprid 17.8 SL @ 25 g a.i./ha, with 3.55, 4.57, 4.59 and 5.01 aphids per leaf, respectively. Highest population was recorded in untreated plots (25.29 aphids per leaf).

The data reveals that recommended doses of imidacloprid (25 g a.i./ha), irrespective of formulation (17.8 SL & 70 WG), were effective in controlling aphid population. It appears that recommended dose is effective in controlling the population. The desired efficacy of imidacloprid is obtained with the recommended dose of imidacloprid. Results indicated that all treatments were found to be effective against *A. gossypii* on okra. Imidacloprid 17.8 SL @ 30 g a.i./ha and imidacloprid 70 WG @ 30 g a.i./ha excelled over all the treatments. It was followed by imidacloprid 17.8 SL @ 25 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha and imidacloprid 70 WG @ 25 g a.i./ha.

The present investigation is in agreement with Preetha *et al.* (2007) [15] who reported that imidacloprid 17.8 SL @ 25 g a.i/ha was effective in controlling aphids. Misra, (2002) [2] reported that imidacloprid and thiamethoxam, both belonging to nitroguanidine group used at 25 g a.i/ha proved significant in controlling aphids on okra. Bagade *et al.* (2010) [3] reported that imidacloprid (0.004%) was found promising in checking the population of aphids infesting okra. Gosalwad *et al.* (2008) [5] reported that imidacloprid 17.8 SL @ 40 g a.i/ha and 20 g a.i/ha were found effective in management of aphids in okra. Shinde *et al*. (2011) [18] reported that imidacloprid 0.004 per cent was most effective treatment for the control of okra aphids.

Jassid, *A. biguttula biguttula*

Data on population of jassids *Amrasca bigutulla bigutulla* in case of different formulations of imidacloprid is given in Table 3.

First Spray

Jassid population at a DBS varied from 15.24 to 19.71 per leaf in different treatments and there was no significant difference among the treatments.

Considering the mean population of jassids after first spray, lowest population was observed in treatment of imidacloprid 17.8 SL @ 30 g a.i./ha (2.77 jassids per leaf). It was followed by imidacloprid 70 WG @ 30 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha, imidacloprid 70 WG @ 25 g a.i./ha and imidacloprid 17.8 SL @ 25 g a.i./ha, with 3.24, 4.25, 4.30 and 5.20 jassids per leaf, respectively. Highest population was recorded in untreated plots. (20.41 jassids/leaf)

Second Spray

The data (Table 4) revealed that jassid population at a DBS varied from 14.63 to 20.85 in different treatments and there was no significant difference among them.

Considering the mean population of no jassids after second spray, lowest population was observed in treatment of imidacloprid 17.8 SL @ 30 g a.i./ha (3.52 jassids per leaf). It was followed by imidacloprid 70 WG @ 30 g a.i./ha, imidacloprid 17.8 SL @ 25 g a.i./ha, imidacloprid 70 WG @ 25 g a.i./ha and thiamethoxam 25 WG @ 25 g a.i./ha with 3.60, 4.33, 4.35 and 4.76 jassids per leaf, respectively. Highest population was recorded in untreated plots (21.92 jassids/leaf).

The data reveals that recommended doses of imidacloprid (25 g a.i./ha), irrespective of formulation (17.8 SL & 70 WG), were effective in controlling jassid population. It appears that recommended dose is effective in controlling the population. The desired efficacy of imidacloprid is obtained with the recommended dose of imidacloprid.

Result indicated that all treatments were found to be effective against *A. biguttula biguttula* on okra. Imidacloprid 17.8 SL 30 g a.i./ha and imidacloprid 70 WG 30 g a.i./ha excelled over all other treatments. Imidacloprid 17.8 SL 25 g a.i./ha and imidacloprid 70 WG 25 g a.i./ha were next to follow in order of effectiveness. All the spray formulations were found effective in reducing the jassid population for three to seven days with gradual increase in the population with advancement of time.

Superiority of imidacloprid 17.8 SL @ 30 g a.i./ha against *A. biguttula biguttula* as obtained in present investigation is in agreement with Preetha *et al.* (2009a) [16] who found that imidacloprid 17.8 SL @ 25 g a.i./ha was effective against jassids. Honnappagouda *et al* (2011) [11] also reported that imidacloprid 17.8 SL @ 25 g a.i./ha was found superior against jassids. Shinde *et al*. (2011) [18] reported that imidacloprid 0.004 per cent was most effective treatment for the control of okra jassids. Bagade and Ambekar (2010) [3] also observed that imidacloprid (0.004%) was most superior treatment against jassids. Mitalilal *et al.* (2005) [10] reported that imidacloprid at 40 g a.i./ha was best treatment in reducing jassid population in okra.

Marketable yield of okra

The results pertaining to the marketable fruit yield of okra fruits are presented in Table 8. It could be seen that imidacloprid 17.8 SL @ 30 g a.i./ha registered higher yield of 60.49 q/ha with maximum per cent (53.11) increase in yield over control. This was followed by imidacloprid 70 WG @ 30 g a.i./ha (59.26 q/ha) with 49.99 per cent increase in yield over control. Next in order of effectiveness were thiamethoxam 25 WG @ 25 g a.i./ha (55.56 q/ha) and imidacloprid 70 WG @ 25 g a.i./ha (53.55 q/ha). They were

followed by imidacloprid 17.6 SL @ 25 g a.i./ha, dimethoate 30 EC @ 200 g a.i./ha, acetamiprid 20 SP @ 10 g a.i./ha which registered 53.09 q/ha, 51.85 q/ha and 50.62 q/ha yield of okra, respectively. Imidacloprid 17.6 SL @ 20 g a.i./ha registered 46.91 q/ha yield of okra with minimum per cent (18.74) increase in yield over control.

Considerable yield advantages due to effective control of *A. gossypii* and *A. biguttula biguttula* in okra, particularly through the use of imidacloprid 17.8 SL 30 g a.i./ha as observed in present investigation is in agreement with Krishnakumar *et al.* (2001) [8] who reported that imidacloprid and thiamethoxam were found effective in controlling jassids with highest yield of okra. Also Singh *et al.* (2005) [19] reported maximum yield of okra (87.4 q/ha) with Confidor 350 SC at 75 ml/ha. Anitha *et al.* (2009) [1] reported highest fruit yield of okra with imidacloprid 200 SL @ 0.2 ml/lit, followed by thiamethoxam 70 WS @ 0.2 g/lit.

The results of the present studies revealed that neonicotinoids *viz.* imidacloprid and thiamethoxam were most effective in controlling the aphids and jassids in okra. Farmers may be advised to use these novel insecticides at recommended dose. Further excess use of these insecticide may be avoided to reduce continuous selection pressure. In order to prolong useful life of these novel insecticides, dimethoate can be used as an alternative.

Table 1: Performance of insecticides against *A. gossypii* under field conditions (I Spray).

No.	Treatment	Dosage	No. of aphids/leaf							Mean
		(g a.i./ha)	Precount(DBS)	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	
1	Imidacloprid 70 WG	20	22.44	4.07	4.73	4.80	8.17	10.27	11.69	7.29
			(4.83)	(2.25)	(2.39)	(2.41)	(3.03)	(3.36)	(3.48)	(2.82)
2	Imidacloprid 70 WG	25	20.78	1.97	2.63	2.97	3.33	7.53	10.80	4.87
			(4.67)	(1.72)	(1.90)	(1.99)	(2.08)	(2.92)	(3.24)	(2.31)
3	Imidacloprid 70 WG	30	21.93	0.83	1.17	1.50	1.57	4.93	10.73	3.51
			(4.78)	(1.35)	(1.48)	(1.58)	(1.60)	(2.44)	(3.12)	(1.93)
4	Imidacloprid 17.8 SL	20	18.49	3.93	4.23	4.47	5.62	10.42	12.31	6.83
			(4.41)	(2.22)	(2.28)	(2.33)	(2.57)	(3.38)	(3.61)	(2.73)
5	Imidacloprid 17.8 SL	25	19.96	1.37	2.33	3.11	2.53	8.89	11.42	4.94
			(4.57)	(1.54)	(1.82)	(2.02)	(1.88)	(3.14)	(3.42)	(2.30)
6	Imidacloprid 17.8 SL	30	20.56	0.63	0.90	1.17	1.53	4.44	10.49	3.23
			(4.63)	(1.28)	(1.38)	(1.47)	(1.59)	(2.33)	(3.12)	(1.87)
7	Acetamiprid 20 SP	10	22.40	1.67	4.02	6.13	8.72	9.28	14.89	7.43
			(4.83)	(1.63)	(2.23)	(1.97)	(3.12)	(3.19)	(3.93)	(2.55)
8	Thiamethoxam 25 WG	25	21.56	1.51	2.00	2.89	3.96	5.46	13.20	4.78
			(4.74)	(1.58)	(1.73)	(1.97)	(2.23)	(2.54)	(3.73)	(2.29)
9	Dimethoate 30 EC	200	20.07	4.06	4.38	9.37	13.71	16.74	20.37	11.44
			(4.59)	(2.25)	(2.31)	(3.22)	(3.83)	(4.21)	(5.02)	(4.47)
10	Control		21.78	21.89	22.83	23.04	23.16	23.27	24.27	23.08
			(4.77)	(4.78)	(4.88)	(4.90)	(4.91)	(4.93)	(5.12)	(4.90)
	S.E ±		0.14	0.06	0.10	0.08	0.04	0.06	0.07	
	CD at 5 %		NS	0.18	0.29	0.23	0.12	0.17	0.21	
	Figures in paranthesis are $\sqrt{(x + 0.5)}$ transformed values DAS- Days After Spraying DBS- Days Before Spraying									

Table 2: Performance of insecticides against *A. gossypii* under field conditions (II Spray)

No.	Treatment	Dosage	No. of aphids/leaf							
		(g a.i./ha)	Precount(DBS)	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	Mean
1	Imidacloprid 70 WG	20	20.38	4.06	4.52	5.19	6.04	8.94	10.67	6.57
			(4.62)	(2.25)	(2.35)	(2.48)	(2.65)	(3.15)	(3.42)	(2.72)
2	Imidacloprid 70 WG	25	19.21	2.30	2.90	3.55	3.80	7.39	10.10	5.01
			(4.50)	(1.82)	(1.97)	(2.13)	(2.19)	(2.89)	(3.33)	(2.39)
3	Imidacloprid 70 WG	30	17.11	1.09	1.38	1.73	2.47	5.62	9.10	3.55
			(4.25)	(1.45)	(1.54)	(1.65)	(1.86)	(2.57)	(3.18)	(2.03)
4	Imidacloprid 17.8 SL	20	17.15	4.27	4.23	4.78	5.46	7.46	10.07	6.04
			(4.26)	(2.29)	(2.28)	(2.40)	(2.54)	(2.90)	(3.32)	(2.62)
5	Imidacloprid 17.8 SL	25	19.59	1.90	2.72	3.02	3.49	6.39	9.22	4.59
			(4.54)	(1.70)	(1.93)	(2.010	(2.12)	(2.72)	(3.20)	(2.31)
6	Imidacloprid 17.8 SL	30	16.03	1.00	1.10	1.27	1.97	4.79	8.48	3.12
			(4.13)	(1.41)	(1.45)	(1.51)	(1.72)	(2.39)	(3.08)	(1.93)
7	Acetamiprid 20 SP	10	20.87	2.69	4.10	5.33	7.84	9.03	11.17	6.52
			(4.68)	(1.92)	(2.26)	(2.51)	(2.97)	(3.17)	(3.48)	(2.67)
8	Thiamethoxam 25 WG	25	15.97	1.67	3.06	3.06	3.06	7.04	9.29	4.57
			(4.12)	(1.63)	(2.01)	(2.01)	(2.01)	(2.83)	(3.21)	(2.52)
9	Dimethoate 30 EC	200	18.23	3.90	4.29	8.67	10.36	13.42	16.77	9.57
			(4.34)	(2.21)	(2.30)	(3.11)	(3.37)	(3.79)	(4.21)	(3.17)
10	Control		24.33	24.33	24.88	25.07	25.58	25.76	26.09	25.29
			(4.93)	(4.93)	(5.09)	(5.11)	(5.16)	(5.17)	(5.21)	(5.11)
	S.E ±		0.26	0.23	0.05	0.07	0.06	0.07	0.07	
	CD at 5 %		NS	0.70	0.21	0.22	0.21	0.21	0.22	
Figures in paranthesis are $\sqrt{(x + 0.5)}$ transformed values DAS- Days After Spraying DBS- Days Before Spraying										

Table 3: Performance of insecticides against *A.biguttula biguttula* under field conditions (I Spray)

No.	Treatment	Dosage	No. of jassids/leaf							
		(g a.i./ha)	Precount(DBS)	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	Mean
1	Imidacloprid 70 WG	20	17.44	2.87	3.64	4.11	6.97	8.63	10.38	6.10
			(4.29)	(1.97)	(2.15)	(2.26)	(2.820	(3.10)	(3.37)	(2.61)
2	Imidacloprid 70 WG	25	16.32	1.34	2.10	3.03	4.48	5.04	9.83	4.30
			(4.16)	(1.53)	(1.76)	(2.01)	(2.34)	(2.46)	(3.29)	(2.23)
3	Imidacloprid 70 WG	30	17.11	0.94	1.17	1.33	2.85	3.81	9.62	3.24
			(4.25)	(1.39)	(1.47)	(1.53)	(1.64)	(2.19)	(3.26)	(1.95)
4	Imidacloprid 17.8 SL	20	15.24	2.92	3.77	4.15	6.86	7.59	12.21	6.25
			(4.02)	(1.98)	(2.18)	(2.27)	(2.80)	(2.93)	(3.63)	(2.63)
5	Imidacloprid 17.8 SL	25	18.34	1.42	2.66	3.11	6.63	7.11	10.26	5.20
			(4.40)	(1.56)	(1.91)	(2.03)	(2.76)	(2.85)	(3.36)	(2.41)
6	Imidacloprid 17.8 SL	30	15.69	0.74	1.10	1.27	1.98	2.72	8.56	2.77
			(4.06)	(1.32)	(1.45)	(1.50)	(1.52)	(1.92)	(3.09)	(1.85)
7	Acetamiprid 20 SP	10	17.13	1.45	2.43	3.41	8.07	4.26	10.29	5.22
			(4.26)	(1.57)	(1.85)	(2.09)	(3.01)	(2.29)	(3.36)	(2.46)
8	Thiamethoxam 25 WG	25	18.61	1.34	2.34	3.20	3.85	8.07	9.90	4.25
			(4.43)	(1.53)	(1.83)	(2.04)	(2.85)	(3.01)	(3.30)	(2.22)
9	Dimethoate 30 EC	200	17.68	3.64	8.11	10.80	11.38	12.82	15.78	10.42
			(4.32)	(2.15)	(3.02)	(3.43)	(3.51)	(3.72)	(4.10)	(3.32)
10	Control		19.71	19.90	19.96	20.03	20.40	20.74	21.44	20.41
			(4.55)	(2.15)	(4.58)	(4.59)	(4.63)	(4.66)	(4.74)	(4.22)
	S.E $\pm$		0.12	0.03	0.04	0.06	0.05	0.05	0.06	
	CD at 5 %		0.34	0.09	0.12	0.18	0.18	0.15	0.19	
Figures in paranthesis are $\sqrt{(x + 0.5)}$ transformed values DAS- Days After Spraying DBS- Days Before Spraying										

Table 4: Performance of insecticides against *A.biguttula biguttula* under field conditions (II Spray)

No.	Treatment	Dosage	No. of jassids/leaf							
		(g a.i./ha)	Precount(DBS)	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	Mean
1	Imidacloprid 70 WG	20	16.20	2.59	3.44	4.63	5.85	7.51	9.48	5.58
			(4.15)	(1.89)	(2.11)	(2.37)	(2.62	(2.92)	(3.24)	(2.52)
2	Imidacloprid 70 WG	25	15.51	1.31	2.69	3.19	4.77	6.01	8.11	4.35
			(4.06)	(1.52)	(1.92)	(2.05)	(2.40)	(2.65)	(3.02)	(2.26)
3	Imidacloprid 70 WG	30	14.82	0.91	1.36	2.22	3.81	5.64	8.04	3.60
			(3.98)	(1.38)	(1.53)	(1.79)	(2.19)	(2.58)	(3.01)	(2.07)
4	Imidacloprid 17.8 SL	20	14.69	2.92	3.37	4.26	5.88	6.47	9.51	5.40
			(3.96)	(1.98)	(2.09)	(2.29)	(2.62)	(2.73)	(3.24)	(2.49)
5	Imidacloprid 17.8 SL	25	16.80	1.29	2.27	3.27	4.30	6.07	8.76	4.33
			(4.22)	(1.51)	(1.81)	(2.07)	(2.30)	(2.66)	(3.12)	(2.24)
6	Imidacloprid 17.8 SL	30	14.63	0.63	1.27	2.19	3.33	5.28	8.08	3.52
			(3.95)	(1.28)	(1.50)	(1.79)	(2.08)	(2.51)	(3.01)	(2.04)
7	Acetamiprid 20 SP	10	16.73	1.45	2.75	4.01	6.74	7.78	8.95	5.14
			(4.21)	(1.57)	(1.93)	(2.23)	(2.78)	(2.96)	(3.15)	(2.41)
8	Thiamethoxam 25 WG	25	16.43	1.28	2.09	3.41	5.02	6.93	8.89	4.76
			(4.17)	(1.51)	(1.76)	(2.10)	(2.45)	(2.82)	(3.14)	(2.32)
9	Dimethoate 30 EC	200	17.82	3.26	4.30	9.07	12.15	14.18	15.67	9.77
			(4.34)	(2.06)	(2.30)	(3.17)	(3.62)	(3.90)	(4.08)	(3.19)
10	Control		20.85	21.22	21.55	21.63	22.04	22.30	22.81	21.92
			(4.67)	(4.71)	(4.75)	(4.76)	(4.80)	(4.83)	(4.88)	(4.79)
	S.E $\pm$		0.05	0.04	0.04	0.03	0.05	0.03	0.04	
	CD at 5 %		NS	0.11	0.13	0.10	0.14	0.10	0.11	
Figures in paranthesis are $\sqrt{(x + 0.5)}$ transformed values DAS- Days After Spraying DBS- Days Before Spraying										

Table 8: Marketable yield of okra

Sr. No.	Treatments	Dose	Marketable fruit yield of okra		Per cent increase
		g.a.i/ha	kg/plot	q/ha	over control
1	Imidacloprid 70 WG	20	4.02	49.63	25.61
2	Imidacloprid 70 WG	25	4.34	53.55	35.54
3	Imidacloprid 70 WG	30	4.80	59.26	49.99
4	Imidacloprid 17.8 SL	20	3.80	46.91	18.74
5	Imidacloprid 17.8 SL	25	4.30	53.09	34.36
6	Imidacloprid 17.8 SL	30	4.90	60.49	53.11
7	Acetamiprid 20 SP	10	4.10	50.62	28.11
8	Thiamethoxam 25 WG	25	4.50	55.56	40.61
9	Dimethoate	200	4.20	51.85	31.24
10	Control		3.20	39.51	
	S.E $\pm$		0.008	0.01	
	CD at 5 %		0.024	0.03	

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