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Effect of water pH on bioefficacy of different insecticides against leaf hopper *Amrasca biguttula biguttula* Ishida on *Bt* cotton

Pawar AA, Bhede BV and Tupe AP

Abstract
An experiment entitled "Effect of water pH on bio-efficacy of different insecticides against major insect pests of *Bt* cotton." was conducted during *kharif* 2021-22 Agricultural Research Farm, Department of Entomology, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) to study the effect of water pH on bio efficacy of insecticides against pests of cotton. The experiment was laid out in split plot design with three replications and twelve treatments. The treatment details of experiment, spraying insecticides with Acidic, Alkaline, and neutral water. The population of leaf hopper observed lowest in treatment with acidic water (5 pH) and highest population was recorded under alkaline water (9 pH). Among insecticides, most superior insecticide treatment was Fipronil 5% SC followed by Profenophos 50% EC and Lambda-cyhalthrin 5% EC against leaf hopper. In interaction effect, insecticides in acidic and neutral water were more effective for management of leafhopper on Bt cotton than insecticides in alkaline water.

Keywords: Cotton, leaf-hopper, pH, insecticides, bio efficacy

Introduction
Cotton is one of the principal commercial crops in India. It plays a vital role in Indian economy, provides direct employment through farming and indirect employment in cotton related industry. The area, production and productivity in Maharashtra during 2020-21 was 42.86 lakh ha, 95.88 lakh bales and 380 kg lint/ha, respectively In Maharashtra, cotton is grown in Maharashtra, Vidharbha and Khandesh regions (Anonymous, 2020) [2].

In India *Bt* cotton is the only genetically modified crop presently cultivated which has incorporated Cry 1 Ac and Cry 2 Ab gene from the soil bacteria (*Bacillus thuringiensis*). In initial years, *Bt* cotton effectively controlled key Lepidopteran pests and has become a cornerstone in overall pest management. Now major issues about *Bt* cotton in India are incidence of pink bollworm, whitefly and some sucking pests (Anonymous, 2018) [1]. The pH of water can negatively affect the stability of some pesticides. A pesticide may lose effectiveness when mixed with water. A chemical reaction known as hydrolysis causes pesticide molecules to break apart, releasing individual ions that reassemble with other ions. New combinations have no insecticidal or miticidal properties, when compromises the overall effectiveness of the pesticide application. The quality of water affects the efficacy of insecticides. Therefore, an attempt was made to study "Effect of water pH on bioefficacy of different insecticides against sucking pests and bollworm complex of Bt cotton" at Department of Agricultural Entomology, VNMKV, Parbhani during *Kharif* 2021-22

Methodology
The field experiment was conducted at Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra) during *Kharif* season of the year 2021-22 under rained condition. The experiment was laid out in split plot design having 3 main and 4 sub treatments. The treatment details are as below.

Table 1: Treatment details

Tr. No.	Main treatment	Tr. No.	Sub treatment
M_1	Acidic pH (5 pH)	S_1	Azadirachtin 3000 ppm @ 2500 ml/ha
M_2	Neutral pH (7 pH)	S_2	Fipronil 5% SC @ 1500 ml/ha
M_3	Alkaline pH (9 pH)	S_3	Profenophos 50% EC @ 1500 ml/ha
		S_4	Lambda-Cyhalothrin 5% EC @ 300 ml/ha

The pH of water was adjusted as per requirement. Normal water was having PH 6.7 and the different pH of normal water was adjusted for 500 lit of water. For 5 pH, 7 pH and 9 pH, normal water was treated with 0.24 ml of citric acid, 0.05 ml of Ammonia and 0.60 ml of Ammonia, respectively. Five plants were randomly selected from each plot and tied with tags, while plants located at border were avoided for observations. The observations recorded at 24 hours before the application of spray and post–treatment observations were recorded at 1, 3, 7 and 14 days after spray. The data tabulated on population of leafhopper were subjected to appropriate transformation and analyzed using OPSTAT software.

Results and Discussion

The leafhopper infestation was noticed during first, second and third spraying and the observations of nymphs and adults of leafhopper were recorded.

First Spraying

The population of leafhopper was recorded before and after first spraying and is presented in Table 2.

Main treatment effect: The data of leafhopper recorded one day before spray and 1 DAS was non-significant showing uniform distribution in all experimental treatment plots. On 3 DAS, the lowest number of leafhopper was found in the treatment of acidic pH (5.42/3 leaves) and it is at par with Neutral pH (5.60/3 leaves). The highest population of leafhopper was noticed in alkaline pH (6.30/3 leaves) likewise, on 7 and 14 DAS, the leafhopper population was less in the treatment of acidic P^H and at par with Neutral pH. The population was more in alkaline pH.

The average data of leafhopper population after treatment application showed that the spray solution having acidic pH (5.84/3 leaves) and neutral pH (6.08/3 leaves) were effective in reducing leafhopper population than alkaline pH (6.78/3 leaves).

Sub treatment effect: The pre-count of leafhopper population was non-significant. On 1 DAS, the population of leafhopper was significantly lowest in the treatment of Fipronil 5% SC (5.39/3 leaves) and it was followed by Profenophos 50% EC (5.84/3leaves) and Lambda-cyhalothrin 5% EC (5.96/3 leaves). Significantly highest population was observed in Azadirachtin 3000 ppm (7.87/3 leaves).

On 3 DAS, the lowest number of leafhopper was found in the treatment of Fipronil 5% SC (4.82/3 leaves). Profenophos 50% EC (5.31/3leaves) and Lambda-cyhalothrin 5% EC (5.69/3 leaves) were the next better treatments. The plots treated with Azadirachtin 3000 ppm recorded maximum leafhopper population (7.27/3 leaves) similarly, on 7 and 14 DAS, Fipronil 5% SC recorded minimum leafhoppers and followed by Profenophos 50% EC, Lambda-cyhalthrin5% EC and Azadirachtin.

The average data after first spraying reported that the leafhoppers were effectively managed by Fipronil 5% SC. The next best treatments were Profenophos 50% EC and Lambda-cyhalthrin 5% C. The maximum population of leafhopper was found in Azadirachtin 3000 ppm.

Table 2: Effect of water pH on efficacy of different insecticides after first spraying against leafhopper on cotton during 2021-22

Treatments	No. of leafhoppers/3 leaves					
	Precount	1 DAS	3 DAS	7 DAS	14 DAS	Average
Main plots - Water pH (M)						
Acidic pH (5 pH) (M1)	9.95 (3.31)*	5.80 (2.60)	5.42 (2.52)	4.70 (2.38)	7.43 (2.89)	5.84
Neutral pH (7 pH) (M2)	9.99 (3.34)	6.36 (2.70)	5.60 (2.56)	4.88 (2.41)	7.47 (2.89)	6.08
Alkaline pH (9 pH) (M3)	9.92 (3.30)	6.63 (2.75)	6.30 (2.69)	5.52 (2.54)	8.66 (3.07)	6.78
S.Em.±	0.02	0.01	0.01	0.02	0.04	
C.D	NS	NS	0.05	0.08	0.16	
Sub plots – Insecticide (S)						
Azadirachtin 3000 ppm (S1)	9.88 (3.30)	7.87 (2.97)	7.27 (2.87)	6.61 (2.75)	10.92 (3.45)	8.17
Fipronil 5% SC (S2)	9.97 (3.31)	5.39 (2.52)	4.82 (2.40)	4.10 (2.25)	6.16 (2.67)	5.12
Profenophos 50%EC (S3)	10.00 (3.32)	5.84 (2.61)	5.31 (2.51)	4.44 (2.33)	6.34 (2.71)	5.49
Lambda-cyhalothrin 5% EC (S4)	9.97 (3.31)	5.96 (2.63)	5.69 (2.58)	4.97 (2.44)	7.99 (2.98)	6.15
S.Em.±	0.03	0.02	0.03	0.02	0.04	
C.D	NS	0.05	0.08	0.07	0.12	
Interaction Effect (MxS)						
M1S1	9.77 (3.28)	7.50 (2.91)	6.87 (2.80)	5.90 (2.62)	10.27 (3.35)	7.63
M1S2	10.17 (3.34)	5.10 (2.46)	4.40 (2.32)	3.87 (2.20)	5.93 (2.63)	4.83
M1S3	9.97 (3.31)	5.28 (2.50)	4.90 (2.43)	4.13 (2.26)	6.13 (2.67)	5.11
M1S4	9.90 (3.30)	5.33 (2.51)	5.50 (2.54)	4.90 (2.42)	7.40 (2.89)	5.78
M2S1	10.00 (3.32)	8.00 (3.00)	7.00 (2.82)	6.13 (2.67)	10.40 (3.37)	7.88

M2S2	9.73 (3.28)	5.50 (2.55)	4.73 (2.39)	4.03 (2.24)	6.10 (2.66)	5.09
M2S3	10.10 (3.33)	5.77 (2.59)	5.13 (2.47)	4.37 (2.31)	6.20 (2.68)	5.37
M2S4	10.13 (3.34)	6.17 (2.67)	5.53 (2.55)	4.97 (2.44)	7.17 (2.85)	5.96
M3S1	9.87 (3.29)	8.10 (3.01)	7.93 (2.99)	7.80 (2.96)	12.10 (3.62)	8.98
M3S2	10.00 (3.31)	5.57 (2.56)	5.33 (2.50)	4.40 (2.32)	6.43 (2.72)	5.43
M3S3	9.93 (3.30)	6.49 (2.73)	5.90 (2.63)	4.83 (2.41)	6.70 (2.77)	5.98
M3S4	9.87 (3.29)	6.37 (2.71)	6.03 (2.65)	5.03 (2.46)	9.40 (3.19)	6.71
S.Em.±	0.05	0.02	0.03	0.04	0.08	
C.D.	NS	NS	NS	0.13	NS	

* Figures in parentheses are Square root transformed values

Interaction Effect (Water pH x Insecticide): The interaction of main treatment and sub treatment observations of cotton leafhopper showed that the precount, 1, 3 and 14 DAS were non-significant. The interaction showed significant differences on 7 DAS.

On 7 DAS, the treatment Fipronil 5% SC in acidic water showed minimum population of cotton leafhopper (3.87/3 leaves) and it was at par with fipronil 5% SC in neutral water (4.03/3 leaves), profenophos 50% EC in acidic water (4.13/3 leaves), profenophos 50% EC in neutral water (4.37/3 leaves) and fipronil 5% SC in alkaline water (4.40/3 leaves). The highest leafhoppers were noticed in Azadirachtin 3000 ppm in alkaline water (7.80/3 leaves).

The average data indicated that the leafhopper was effectively managed by spraying Fipronil 5% SC in acidic solution, followed by Fipronil 5% SC in neutral solution, profenophos 50% EC in acidic solution, profenophos 50% EC in neutral solution, Fipronil 5% SC in alkaline solution, lambda-cyhalothrin 5% EC in acidic and neutral solution, profenophos 50% EC in alkaline solution, lambda-cyhalothrin 5% EC in alkaline solution, azadirachtin 3000 ppm acidic, neutral and alkaline solution.

Second Spraying

The data recorded on population of leafhopper before and after second spraying are presented in Table 3.

Main treatment effect: The population of leafhopper before spray was uniform in all treatment plots since the average population of leafhopper was statistically non-significant.

The after treatment observations recorded on the first day indicated that the incidence was lowest in the treatment of acidic pH (4.41/3 leaves) and at par with Neutral pH(4.50/3 leaves). The population was found highest in alkaline pH (5.09/3 leaves). Similarly on 3, 7 and 14 DAS, the leafhopper was minimum in acidic and neutral pH and maximum in alkaline pH.

The average data indicated that the acidic spray solution (5.26/3 leaves) reduced leafhopper most effectively, followed by neutral (5.73/3 leaves) and alkaline (6.49/3 leaves) spray solution.

Sub treatment effect: In pre count, the lowest number of leafhoppers was found in the treatment of Fipronil 5% SC (7.40/3 leaves) and followed by Profenophos 50% EC (7.87/3 leaves). Lambda-cyhalothrin 5% EC (8.76/3 leaves) and Azadirachtin 3000 ppm (13.08/3 leaves).

On 1 DAS, the leafhopper population was significantly reduced in Fipronil 5% SC (3.77/3 leaves). It was followed by Profenophos 50% EC (3.99/3 leaves), Lambda-cyhalothrin 5% EC (6.24/3 leaves). The Azadirachtin 3000 ppm recorded maximum. Population (9.81/3 leaves). Similar trend was observed on 7 and 14 DAS.

The average data revealed that Fipronil 5% SC (3.91/3 leaves) was most effective against leafhopper than other treatments. The next better insecticides were Profenophos 50% EC (4.76/3 leaves) and Lambda-cyhalothrin 5% EC (5.87/3 leaves). Azadirachtin 3000 ppm (8.77/3 leaves) recorded more population as compared to above chemical insecticides.

Interaction Effect (Water pH x Insecticides): The interaction of main treatment and sub treatment showed non significant differences on one day before spray, 3,7 and 4 DAS. The significant interaction was observed on 1 DAS. On one day after spraying, the interaction effect of Fipronil 5% SC in acidic water (3.67/3 leaves) was most effective and at par with Fipronil 5% SC in neutral water (3.70/3 leaves), profenophos in acidic water (3.87/3 leaves), profenophos in neutral water (3.90/3 leaves) and Fipronil 5% SC in alkaline water (3.93/3 leaves). The least effective interaction was Azadirachtin 3000 ppm in alkaline water (11.13/3 leaves).

The average data showed that the leafhoppers were effectively reduced by spraying Fipronil 5% SC in acidic water (3.55/3 leaves), followed by Fipronil 5% SC in neutral water (3.88/3 leaves),Profenophos 50% EC in acidic water (4.25/3 leaves), Fipronil 5% SC in alkaline water (4.30/3 leaves), Profenophos 50% EC in neutral water (4.69/3 leaves), Lambda-cyhalothrin 5% EC in acidic water (5.29/3 leaves), Lambda-cyhalothrin 5% EC in alkaline water (5.33/3 leaves), Lambda-cyhalothrin 5% EC in neutral water (5.68/3 leaves), Azadirachtin 3000 ppm in acidic water (7.96/3 leaves), Azadirachtin 3000 ppm in neutral water (8.64/3 leaves) and Azadirachtin 3000 ppm in alkaline water (7.96/3 leaves).

Table 3: Effect of water pH on efficacy of different insecticides after second spraying against leafhopper on cotton during 2021-22

Treatments	No. of leafhoppers/3 leaves					
	Precount	1 DAS	3 DAS	7 DAS	14 DAS	Average
Main plots - Water pH (M)						
Acidic pH (5 pH) (M1)	8.87 (3.12)*	4.41 (2.54)	3.51 (2.31)	5.47 (2.70)	5.53 (2.53)	5.26
Neutral pH (7 pH) (M2)	8.92 (3.13)	4.50 (2.53)	3.58 (2.32)	6.38 (2.59)	6.28 (2.67)	5.73
Alkaline pH (9 pH) (M3)	10.04 (3.29)	5.09 (2.71)	4.52 (2.51)	6.52 (2.61)	7.26 (2.86)	6.49
S.Em.±	0.04	0.01	0.03	0.04	0.06	
C.D	NS	0.04	0.11	0.13	0.24	
Sub plots – Insecticide (S)						
Azadirachtin 3000 ppm (S1)	13.08 (3.75)	9.81 (3.28)	7.90 (2.98)	8.89 (3.18)	8.49 (3.07)	8.77
Fipronil 5% SC (S2)	7.40 (2.89)	3.77 (2.18)	2.97 (1.98)	4.44 (2.29)	4.49 (2.33)	3.91
Profenophos 50%EC (S3)	7.87 (2.97)	3.99 (2.23)	3.71 (2.15)	5.04 (2.44)	6.28 (2.69)	4.76
Lambda-cyhalothrin 5% EC (S4)	8.76 (3.11)	6.24 (2.69)	4.93 (2.42)	6.11 (2.65)	6.18 (2.66)	5.87
S.Em.±	0.04	0.01	0.04	0.06	0.04	
C.D	0.13	0.04	0.12	0.18	0.11	
Interaction Effect (MxS)						
M1S1	12.73 (3.70)	9.00 (3.16)	7.50 (2.91)	7,57 (3.27)	7.77 (2.95)	7.96
M1S2	7.40 (2.89)	3.67 (2.16)	2.80 (1.96)	3.93 (2.33)	3.80 (2.18)	3.55
M1S3	7.93 (2.98)	3.87 (2.21)	3.10 (2.01)	4.57 (2.52)	5.47 (2.54)	4.25
M1S4	7.40 (2.89)	5.70 (2.62)	4.57 (2.35)	5.80 (2.66)	5.10 (2.46)	5.29
M2S1	12.20 (3.63)	9.10 (3.17)	7.60 (2.93)	9.40 (3.22)	8.47 (3.07)	8.64
M2S2	7.20 (2.86)	3.70 (2.15)	2.87 (1.94)	4.63 (2.19)	4.33 (2.30)	3.88
M2S3	7.47 (2.90)	3.90 (2.20)	3.17 (2.04)	5.40 (2.33)	6.30 (2.70)	4.69
M2S4	8.80 (3.13)	5.90 (2.58)	4.70 (2.38)	6.10 (2.59)	6.03 (2.63)	5.68
M3S1	14.30 (3.91)	11.13 (3.51)	8.60 (3.10)	9.70 (2.92)	9.23 (3.20)	9.72
M3S2	7.60 (2.93)	3.93 (2.21)	3.17 (2.04)	4.77 (2.35)	5.33 (2.51)	4.30
M3S3	8.20 (3.03)	4.20 (2.27)	4.87 (2.40)	5.17 (2.47)	7.07 (2.84)	5.33
M3S4	10.07 (3.31)	7.13 (2.85)	5.53 (2.53)	6.43 (2.70)	7.40 (2.90)	6.63
S.Em.±	0.08	0.02	0.05	0.05	0.12	
C.D.	NS	0.08	NS	NS	NS	

* Figures in parentheses are Square root transformed values

Third Spraying

The data recorded on population of leafhopper before and after second spraying are presented in Table 4.

Main treatment effect: The population of leafhopper before spray was uniform in all treatment plots since the average population of leafhopper was statistically significant. In pre count, the lowest number of leafhoppers was found in the treatment of acidic (5.85/3 leaves) and followed by neutral (6.36/3 leaves). Alkaline (7.32/3 leaves). The after treatment observations recorded on the first day indicated that the incidence was lowest in the treatment of acidic pH (4.10/3 leaves) and at par with Neutral pH (4.11/3 leaves). The population was found highest in alkaline pH (5.38/3 leaves). Similarly on 3, 7 and 14 DAS, the leafhopper was minimum in acidic and neutral pH and maximum in alkaline pH.

The average data indicated that the acidic spray solution (3.82/3 leaves) reduced leafhopper most effectively, followed by neutral (4.17/3 leaves) and alkaline (5.15/3 leaves) spray solution.

Sub treatment effect: In pre count the lowest number of leafhoppers was found in the treatment of Fipronil 5% SC (5.30/3 leaves) and followed by Profenophos 50% EC (5.35/3 leaves). Lambda-cyhalothrin 5% EC (5.72/3 leaves) and Azadirachtin 3000 ppm (9.67/3 leaves).

On 1 DAS, the leafhopper population was significantly reduced in Fipronil 5% SC (2.44/3 leaves). It was at par with Profenophos 50% EC (2.71/3 leaves). The next best treatment was Lambda-cyhalothrin 5% EC (3.98/3 leaves). The Azadirachtin 3000 ppm recorded maximum population (8.99/3 leaves).

On 3 DAS, the leafhopper population was significantly reduced in Profenophos 50% EC (2.86/3 leaves) and it was at par with Fipronil 5% SC (3.04/3 leaves). The next best treatment was Lambda-cyhalothrin 5% EC (3.84/3 leaves). The Azadirachtin 3000 ppm recorded maximum population (6.58/3 leaves).

On 7 and 14DAS, the leafhopper population was significantly reduced in Fipronil 5% SC. It was at par with Profenophos 50% EC & Lambda-cyhalothrin 5% EC. The Azadirachtin 3000 ppm recorded maximum population.

The average data revealed that Fipronil 5% SC (2.74/3 leaves) was most effective against leafhopper than other treatments. The next better insecticides were Profenophos 50% EC (2.88/3 leaves) and Lambda-cyhalothrin 5% EC (3.75/3 leaves). Azadirachtin 3000 ppm (8.14/3 leaves) recorded more population as compared to above chemical insecticides

Table 4: Effect of water pH on efficacy of different insecticides after third spraying against leafhopper on cotton during 2021-22

Treatments	No. of leafhoppers/3 leaves					
	Precount	1 DAS	3 DAS	7 DAS	14 DAS	Average
Main plots - Water pH (M)						
Acidic pH (5 pH) (M1)	5.85 (2.58)*	4.10 (2.21)	3.37 (2.06)	3.62 (2.10)	4.18 (2.22)	3.82
Neutral pH (7 pH) (M2)	6.36 (2.67)	4.11 (2.20)	3.98 (2.19)	4.00 (2.18)	4.60 (2.31)	4.17
Alkaline pH (9 pH) (M3)	7.32 (2.84)	5.38 (2.44)	4.90 (2.39)	4.87 (2.36)	5.45 (2.47)	5.15
S.Em.±	0.04	0.03	0.05	0.04	0.03	
C.D	0.17	0.11	20	0.14	0.12	
Sub plots – Insecticide (S)						
Azadirachtin 3000 ppm (S1)	9.67 (3.25)	8.99 (3.15)	6.58 (2.74)	7.92 (2.97)	9,09 (3.16)	8.14
Fipronil 5% SC (S2)	5.30 (2.48)	2.44 (1.85)	3.04 (1.99)	2.66 (1.89)	2.82 (1.95)	2.74
Profenophos 50%EC (S3)	5.35 (2.50)	2.71 (1.92)	2.86 (1.94)	2.99 (1.98)	2.97 (1.98)	2.88
Lambda-cyhalothrin 5% EC (S4)	5.72 (2.58)	3.98 (2.21)	3.84 (2.19)	3.09 (2.01)	4.10 (2.24)	3.75
S.Em.±	0.05	0.04	0.06	0.05	0.03	
C.D	0.16	0.12	0.19	0.15	0.10	
Interaction Effect (MxS)						
M1S1	8.70 (3.11)	7.90 (2.98)	5.37 (2.52)	6.79 (2.76)	8.07 (3.00)	7.03
M1S2	4.72 (2.38)	2.40 (1.84)	2.60 (1.89)	2.23 (1.79)	2.60 (1.89)	2.46
M1S3	4.73 (2.38)	2.60 (1.89)	2.30 (1.80)	2.60 (1.89)	2.70 (1.92)	2.55
M1S4	5.23 (2.47)	3.50 (2.11)	3.20 (2.04)	2.87 (1.96)	3.37 (2.07)	3.23
M2S1	9.13 (3.18)	8.00 (2.99)	6.43 (2.72)	7.43 (2.90)	8.47 (3.07)	7.58
M2S2	5.00 (2.44)	2.17 (1.77)	2.57 (1.89)	2.60 (1.87)	2.73 (1.93)	2.52
M2S3	5.25 (2.48)	2.67 (1.91)	2.77 (1.90)	3.00 (1.98)	2.93 (1.96)	2.84
M2S4	6.07 (2.65)	3.60 (2.14)	4.13 (2.26)	2.97 (1.98)	4.27 (2.28)	3.74
M3S1	11.17 (3.47)	11.07 (3.47)	7.93 (2.99)	9.53 (3.24)	10.73 (3.42)	9.82
M3S2	6.17 (2.63)	2.77 (1.93)	3.97 (2.18)	3.13 (2.02)	3.13 (2.03)	3.25
M3S3	6.07 (2.65)	2.87 (1.96)	3.50 (2.12)	3.37 (2.08)	3.27 (2.06)	3.25
M3S4	5.87	4.83	4.20	3.43	4.67	4.28

	(2.61)	(2.40)	(2.26)	(2.10)	(2.37)	
S.Em.±	0.08	0.05	0.10	0.07	0.06	
C.D.	NS	NS	NS	NS	NS	

* Figures in parentheses are Square root transformed values

This finding is similar with Rohini and Prasad (2011) [5] reported that In case of cotton leafhopper, fipronil 5 SC @ 2 ml/L and imidacloprid 17.8 SL @ 0.4 ml/L were found to be promising. Kalyan *et al.* (2012) [6] concluded fipronil 5 SC @ 40 g a.i./ha, imidacloprid 70 WG @ 50 g a.i./ha, spinosad 45 SC @ 75 g a.i/ha. Spinosad, imidacloprid, acephate and fipronil effectively controlled the population of jassids. Paul *et al.* (2018) [7] revealed that highest reduction highest reduction in population of leaf hoppers. Badgujar *et al*., (2014) [3] and Baraskar and Paradkar (2020) [4] observed that Fipronil 5% SC was found effective against the major sucking pests like leafhopper of Bt-cotton crop. Raymond (2016) [9] reported that insecticides, in most cases, are more susceptible to alkaline hydrolysis than either fungicides or plant growth regulators. Insecticide active ingredients in the chemical classes organophosphate (e.g. acephate and chlorpyrifos), carbamate (e.g. methiocarb), and pyrethroid (e.g. bifenthrin, cyfluthrin, and fluvalinate) are most sensitive to alkaline hydrolysis or "high" pH solutions. The present investigations agree with Putter *et al.*, (2017b) [8] who revealed that in both potato and shallot, pest and disease control results are slightly better with spray solutions with a pH 5 compared to pH 8.

Conclusion

Water pH affects the efficacy of insecticides used for management of insect pests of cotton. When the pH of the spray solution is alkaline it is advised to lower the pH to reduce the risk of degradation and consequently lower efficacy of insecticides.

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