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Bioefficacy of cow urine and different types of bio-pesticide against major sucking insect pests of *Bt* cotton

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Abstract
An experiment was conducted to evaluate various doses of cow urine, *i.e*. 25, 50, 75 and 100 per cent in combination with neem oil 1% and neem seed kernel extract (NSKE) 5% for its field bio-efficacy against insect pests of cotton during 2018-19. The experiment was conducted at Farmer's field of Mujukua Village, Anand, Gujarat. Among the evaluated different doses and combinations of cow urine and biopesticides, cow urine 100% + neem oil 1% was found highly effective against aphid, jassid and thrips in *Bt* cotton. However, cow urine 100% + NSKE 5%, cow urine 100%, cow urine 50% + neem oil 1%, cow urine 50% + NSKE 5% and cow urine 75% were also found equally effective in reducing insect pests population during present investigation. The seed cotton yield was recorded higher from plots treated with cow urine 100% + neem oil 1% followed by cow urine 100% + NSKE 5%, cow urine 100%, cow urine 50% + neem oil 1%, cow urine 50% + NSKE 5% and cow urine 75% than other treatments. The lowest (1955 kg/ha) yield of seed cotton was recorded in plots treated with cow urine 25%. The treatment of cow urine 100% + neem oil 1% showed highest net gain over control and realization but, looking to the NICBR (Net Incremental Cost Benefit Ratio), the highest (1: 4.92) return was obtained from the treatment of cow urine 75% and the lowest (1: 1.30) from the treatment of neem oil 1%.

Keywords: bio-efficacy, *Bt* cotton, cow urine, bio-pesticides

1. Introduction
Cotton is one of the important cash crop exercising thoughtful influence on financial side and social affairs of the India and the world as well. As per world cotton scenario, commercial cotton is grown in 77 countries and 123 countries are involved in the cotton related activities. The area under cotton cultivation in the world is about 29.22 million hectares with annual production of 105.71 million bales. India was leading in raw cotton production in the world during 2016-17 and production was up to 35.1 million bales of 480 lb from 10.5 million hectares with a productivity of 568 kg/ha. Gujarat, Maharashtra and Telangana are the major cotton growing states contributing around 70 per cent of the area and 67 per cent of cotton production in India (Anon., 2017) [2]. Gujarat ranks second in area (24.00 lakh ha) and first in production (95.00 lakh bales of 170 kg) in the country (Anon., 2017) [2]. Nearly 148 insect pests have been reported in cotton, out of which 17 have been labelled as major insect pests of cotton (Abbas, 2004) [1]. After introduction of *Bt* cotton, the population of sucking insect pests gradually increased. Among the different sucking insect pests attacking on cotton, aphids (*Aphis gossypii* Glover), leaf hopper (*Amrasca biguttula biguttula* Ishida), whiteflies (*Bemisia tabaci* Gennadius) and thrips, (*Thrips tabaci* Lindeman) are deleterious to crop growth and development (Vennila *et al*., 2000) [7]. In India, farmers are using different kinds of pesticide to control insects on different crops. Insect-pests have developed resistance against recommended doses, due to which farmers have to apply more than recommended doses of pesticides on agriculture crops, which is a serious concern across many states. Over use of pesticides makes food and fodder toxic that causes health problems in human being and animals. This problems can be solved by using bio-pesticides and identifying new sources of pesticides from nature. Cow excreta (dung & urine) has been found useful to improve soil and crop productivity. Cow urine is available in huge quantities in villages and easily affordable. Few studies have suggested that cow urine is useful as pesticide. In *Bt* cotton, use of different kind of chemicals /pesticides to control insects and fungal diseases causes heavy economic burden to farmers.

This burden may be reduced if cow urine application is found useful as pesticide on the crops. Therefore, the present investigation was conducted to evaluate the bioefficacy of cow urine and different biopesticides against sucking insect pests infesting *Bt* cotton.

2. Materials and Methods

The experiment was conducted on farmer's field of Mujukua Village, Gujarat during *kharif* season 2018 - 19 in Randomized Block Design with three replications and twelve treatments. Cotton cultivar was sown, with a spacing of 120 cm between two rows and 60 cm within the rows in gross and net plot of 6.0 x 4.8 m and 4.8 x 2.4 m, respectively. The first spray was made at bud formation stage. Subsequently, second and third sprays were applied at 15 days interval. Spray fluid was applied by using knapsack sprayer. To record the incidence of major insect pests, five plants were selected randomly from net plot area of each treatment and various observations were recorded before first spray and 5, 10 and 15 days after each spray. Observations on sucking insect-pests population were recorded from five leaves (three from top and two from middle region) of five randomly selected plants. Seed cotton yield was recorded at maturity of crop from each treatment. The data obtained were analyzed by following standard statistical technique (Steel and Torrie, 1980) [6].

3. Results and Discussion

The population of insect pests was homogeneous in all the treatments before spray as treatment difference was non-significant.

3.1 Aphid

Pooled over sprays data (Table 1) revealed that cow urine 100% + neem oil 1% (13.26/leaf) was found significantly superior to all the evaluated treatments except cow urine 100% + NSKE 5% (13.49/leaf), cow urine 100% (13.71/leaf), cow urine 50% + neem oil 1% (13.94/leaf), cow urine 50% + NSKE 5% (14.17/leaf) and cow urine 75% (14.25/leaf). Lower population of aphids in these treatments showed more effectiveness compared to other treatments. The plots treated with cow urine 25% recorded the maximum (22.73/leaf) aphid population and it was at par with cow urine 50% (21.68/leaf), neem oil 1% (21.87/leaf), NSKE 5% (22.25/leaf) and *B. bassiana* 0.4% (22.54/leaf).

Table 1: Bio-efficacy of cow urine and different type of biopesticides against aphid infesting *Bt* cotton

Sr. No.	Treatments	Conc. (%)	No. of aphid/ leaf days after spray									
			Before spray	First spray			Second spray			Third spray			Pooled
				5	10	15	5	10	15	5	10	15	
T_1	Cow urine	25	4.95a (24.00)	5.08b (25.31)	5.05b (25.00)	5.12b (25.71)	4.97b (24.20)	4.77b (22.25)	4.82b (22.73)	4.62b (20.84)	4.40b (18.86)	4.58b (20.48)	4.82b (22.73)
T_2	Cow urine	50	4.87a (23.22)	4.99b (24.40)	4.92b (23.71)	5.02b (24.70)	4.90b (23.51)	4.66b (21.22)	4.71b (21.68)	4.50b (19.75)	4.27b (17.73)	4.45b (19.30)	4.71b (21.68)
T_3	Cow urine	75	5.12a (25.71)	4.27a (17.73)	4.17a (16.89)	4.19a (17.06)	4.04a (15.82)	3.72a (13.34)	3.84a (14.25)	3.48a (11.61)	3.31a (10.46)	3.63a (12.68)	3.84a (14.25)
T_4	Cow urine	100	4.97a (24.20)	4.23a (17.39)	4.08a (16.15)	4.17a (16.89)	3.93a (14.94)	3.65a (12.82)	3.76a (13.64)	3.40a (11.06)	3.17a (9.55)	3.54a (12.03)	3.77a (13.71)
T_5	Neem Seed Kernel Extract (NSKE)	5	4.84a (22.93)	5.04b (24.90)	5.01b (24.60)	5.08b (25.31)	4.94b (23.90)	4.72b (21.78)	4.75b (22.06)	4.58b (20.48)	4.35b (18.42)	4.50b (19.75)	4.77b (22.25)
T_6	Neem oil	1	4.72a (21.78)	5.01b (24.60)	4.96b (24.10)	5.03b (24.80)	4.92b (23.71)	4.68b (21.40)	4.72b (21.78)	4.51b (19.84)	4.31b (18.08)	4.46b (19.39)	4.73b (21.87)
T_7	Cow urine + Neem oil	50 + 1	4.88a (23.31)	4.25a (17.56)	4.15a (16.72)	4.19a (17.06)	3.94a (15.02)	3.66a (12.90)	3.80a (13.94)	3.44a (11.33)	3.22a (9.87)	3.61a (12.53)	3.80a (13.94)
T_8	Cow urine + Neem oil	100 + 1	4.82a (22.73)	4.18a (16.97)	3.98a (15.34)	4.14a (16.64)	3.87a (14.48)	3.61a (12.53)	3.71a (13.26)	3.36a (10.79)	3.14a (9.36)	3.48a (11.61)	3.71a (13.26)
T_9	Cow urine + NSKE	50 + 5	4.88a (23.31)	4.26a (17.65)	4.16a (16.81)	4.19a (17.06)	4.02a (15.66)	3.69a (13.12)	3.82a (14.09)	3.46a (11.47)	3.27a (10.19)	3.63a (12.68)	3.83a (14.17)
T_{10}	Cow urine + NSKE	100 + 5	4.72a (21.78)	4.20a (17.14)	4.02a (15.66)	4.17a (16.89)	3.91a (14.79)	3.63a (12.68)	3.73a (13.41)	3.38a (10.92)	3.17a (9.55)	3.50a (11.75)	3.74a (13.49)
T_{11}	*Beauveria bassiana*	0.4	4.82a (22.73)	5.06b (25.10)	5.03b (24.80)	5.11b (25.61)	4.95b (24.00)	4.77b (22.25)	4.81b (22.64)	4.60b (20.66)	4.37b (18.60)	4.54b (20.11)	4.80b (22.54)
T_{12}	Control	-	4.91a (23.61)	5.87c (33.96)	6.13c (37.08)	6.22c (38.19)	6.28c (38.94)	6.30c (39.22)	6.34c (39.80)	6.43c (40.84)	6.49c (41.74)	6.58c (42.81)	6.29c (39.06)
C.V. %			10.56	8.63	9.51	10.32	10.58	12.18	11.18	13.27	12.63	10.81	10.98

Notes: Figures in parentheses are retransformed values of $\sqrt{(x+0.5)}$

Treatment mean with letter(s) in common are non-significant by DNMRT at 5% level of significance

3.2 Jassid

Pooled over sprays data (Table 2) revealed that cow urine 100% + neem oil 1% (2.03/leaf), cow urine 100% + NSKE 5% (2.16/leaf), cow urine 100% (2.29/leaf), cow urine 50% + neem oil 1% (2.36/leaf), cow urine 50% + NSKE 5% (2.49/leaf) and cow urine 75% (2.53/leaf) were found superior to the rest of the treatments. The plots treated with cow urine 25% showed maximum (4.52/leaf) jassid population and it was at par with cow urine 50% (4.04/leaf), neem oil 1% (4.17/leaf), NSKE 5% (4.25/leaf) and *B. bassiana* 0.4% (4.38/leaf). Which were less effective as compared to other treatments.

Table 2: Bio-efficacy of cow urine and different type of biopesticides against jassid infesting *Bt* cotton

Sr. No.	Treatments	Conc. (%)	No. of jassid/ leaf days after spray										
			Before spray	First spray			Second spray			Third spray			Pooled
				5	10	15	5	10	15	5	10	15	
T_1	Cow urine	25	2.37a (6.95)	2.26b (4.61)	2.23b (4.47)	2.42b (5.36)	2.28b (4.70)	2.18b (4.25)	2.28b (4.70)	2.20b (4.34)	2.10b (3.91)	2.18b (4.25)	2.24b (4.52)
T_2	Cow urine	50	2.30a (4.79)	2.18b (4.25)	2.15b (4.12)	2.30b (4.79)	2.20b (4.34)	2.04b (3.66)	2.17b (4.21)	2.05b (3.70)	1.98b (3.42)	2.08b (3.83)	2.13b (4.04)
T_3	Cow urine	75	2.22a (4.43)	1.88a (3.03)	1.78a (2.67)	1.98a (3.42)	1.78a (2.67)	1.63a (2.16)	1.76a (2.60)	1.64a (2.19)	1.55a (1.90)	1.67a (2.29)	1.74a (2.53)
T_4	Cow urine	100	2.11a (3.95)	1.81a (2.78)	1.72a (2.46)	1.91a (3.15)	1.69a (2.36)	1.56a (1.93)	1.67a (2.29)	1.56a (1.93)	1.48a (1.69)	1.59a (2.03)	1.67a (2.29)
T_5	Neem Seed Kernel Extract (NSKE)	5	2.42a (5.36)	2.22b (4.43)	2.19b (4.30)	2.37b (5.12)	2.25b (4.56)	2.10b (3.91)	2.22b (4.43)	2.12b (3.99)	2.04b (3.66)	2.13b (4.04)	2.18b (4.25)
T_6	Neem oil	1	2.24a (4.52)	2.21b (4.38)	2.17b (4.21)	2.34b (4.98)	2.22b (4.43)	2.06b (3.74)	2.20b (4.34)	2.09b (3.87)	2.01b (3.54)	2.11b (3.95)	2.16b (4.17)
T_7	Cow urine + Neem oil	50 + 1	1.91a (3.15)	1.86a (2.96)	1.72a (2.46)	1.93a (3.22)	1.75a (2.56)	1.57a (1.96)	1.70a (2.39)	1.60a (2.06)	1.51a (1.78)	1.59a (2.03)	1.69a (2.36)
T_8	Cow urine + Neem oil	100 + 1	2.39a (5.21)	1.71a (2.42)	1.65a (2.22)	1.87a (3.00)	1.64a (2.19)	1.50a (1.75)	1.61a (2.09)	1.45a (1.60)	1.40a (1.46)	1.50a (1.75)	1.59a (2.03)
T_9	Cow urine + NSKE	50 + 5	2.12a (3.99)	1.87a (3.00)	1.77a (2.63)	1.96a (3.34)	1.77a (2.63)	1.61a (2.09)	1.75a (2.56)	1.62a (2.12)	1.54a (1.87)	1.65a (2.22)	1.73a (2.49)
T_{10}	Cow urine + NSKE	100 + 5	2.14a (4.08)	1.78a (2.67)	1.68a (2.32)	1.88a (3.03)	1.65a (2.22)	1.53a (1.84)	1.65a (2.22)	1.50a (1.75)	1.45a (1.60)	1.55a (1.90)	1.63a (2.16)
T_{11}	*Beauveria bassiana*	0.4	2.16a (4.17)	2.25b (4.56)	2.21b (4.38)	2.40b (5.26)	2.27b (4.65)	2.14b (4.08)	2.25b (4.56)	2.17b (4.21)	2.07b (3.78)	2.14b (4.08)	2.21b (4.38)
T_{12}	Control	-	2.24a (4.52)	2.63c (6.42)	2.68c (6.68)	2.74c (7.01)	2.76c (7.12)	2.78c (7.23)	2.86c (7.68)	2.88c (7.79)	2.91c (8.01)	2.97c (8.23)	2.80c (7.34)
C.V. %			9.03	8.45	10.06	8.44	10.15	12.18	11.10	10.98	10.53	10.71	10.28

Notes: Figures in parentheses are retransformed values of √(x+0.5)
Treatment mean with letter(s) in common are non-significant by DNMRT at 5% level of significance

3.3 Thrips

Pooled over sprays data (Table 3) indicated that cow urine 100% + neem oil 1% (5.12/leaf) was found significantly superior to all the evaluated treatments except cow urine 100% + NSKE 5% (5.26/leaf), cow urine 100% (5.36/leaf), cow urine 50% + neem oil 1% (5.55/leaf), cow urine 50% + NSKE 5% (5.70/leaf) and cow urine 75% (5.80/leaf). The plots treated with cow urine 25% indicated the maximum (10.92/leaf) thrips population and it was at par with cow urine 50% (10.13/leaf), neem oil 1% (10.32/leaf), NSKE 5% (10.52/leaf) and *B. bassiana* 0.4% (10.79/leaf).

Table 3: Bio-efficacy of cow urine and different type of biopesticides against thrips infesting bt cotton

Sr. No.	Treatments	Conc. (%)	No. of thrips/ leaf days after spray										
			Before spray	First spray			Second spray			Third spray			Pooled
				5	10	15	5	10	15	5	10	15	
T_1	Cow urine	25	3.57a (12.24)	3.55b (12.10)	3.51b (11.82)	3.63b (12.68)	3.45b (11.40)	3.30b (10.39)	3.43b (11.26)	3.26b (10.13)	3.04b (8.74)	3.27b (10.19)	3.38b (10.92)
T_2	Cow urine	50	3.71a (13.26)	3.46b (11.47)	3.39b (10.99)	3.52b (11.89)	3.36b (10.79)	3.20b (9.74)	3.32b (10.52)	3.11b (9.17)	2.90b (7.91)	3.11b (9.17)	3.26b (10.13)
T_3	Cow urine	75	3.51a (11.82)	2.69a (6.74)	2.57a (6.10)	2.74a (7.01)	2.54a (5.95)	2.43a (5.40)	2.59a (6.21)	2.42a (5.36)	2.22a (4.43)	2.43a (5.40)	2.51a (5.80)
T_4	Cow urine	100	3.72a (13.34)	2.60a (6.26)	2.48a (5.65)	2.68a (6.68)	2.46a (5.55)	2.34a (4.98)	2.46a (5.55)	2.29a (4.74)	2.13a (4.04)	2.36a (5.07)	2.42a (5.36)
T_5	Neem Seed Kernel Extract (NSKE)	5	3.49a (11.68)	3.51b (11.82)	3.45b (11.40)	3.59b (12.39)	3.39b (10.99)	3.24b (10.00)	3.37b (10.86)	3.19b (9.68)	2.95b (8.20)	3.18b (9.61)	3.32b (10.52)
T_6	Neem oil	1	3.63a (12.68)	3.48b (11.61)	3.42b (11.20)	3.53b (11.96)	3.37b (10.86)	3.22b (9.87)	3.35b (10.72)	3.15b (9.42)	2.91b (7.97)	3.16b (9.49)	3.29b (10.32)
T_7	Cow urine + Neem oil	50 + 1	3.48a (11.61)	2.63a (6.42)	2.53a (5.90)	2.69a (6.74)	2.50a (5.75)	2.38a (5.16)	2.49a (5.70)	2.35a (5.02)	2.18a (4.25)	2.38a (5.16)	2.46a (5.55)
T_8	Cow urine + Neem oil	100 + 1	3.42a (11.20)	2.59a (6.21)	2.43a (5.40)	2.65a (6.52)	2.42a (5.36)	2.29a (4.74)	2.40a (5.26)	2.22a (4.43)	2.03a (3.62)	2.33a (4.93)	2.37a (5.12)
T_9	Cow urine + NSKE	50 + 5	3.69a (13.12)	2.68a (6.68)	2.56a (6.05)	2.72a (6.90)	2.53a (5.90)	2.40a (5.26)	2.55a (6.00)	2.40a (5.26)	2.20a (4.34)	2.41a (5.31)	2.49a (5.70)
T_{10}	Cow urine + NSKE	100 + 5	3.61a (12.53)	2.60a (6.26)	2.47a (5.60)	2.67a (6.63)	2.45a (5.50)	2.32a (4.88)	2.43a (5.40)	2.27a (4.65)	2.06a (3.74)	2.34a (4.98)	2.40a (5.26)
T_{11}	*Beauveria bassiana*	0.4	3.82a (14.09)	3.54b (12.03)	3.50b (11.75)	3.60b (12.46)	3.43b (11.26)	3.26b (10.13)	3.41b (11.13)	3.25b (10.06)	3.00b (8.50)	3.24b (10.00)	3.36b (10.79)
T_{12}	Control	-	3.78a (13.79)	4.31c (18.08)	4.44c (19.21)	4.59c (20.57)	4.62c (20.86)	4.64c (21.04)	4.65c (21.12)	4.77c (22.25)	4.85c (23.11)	4.89c (23.44)	4.63c (20.94)
C.V. %			12.61	12.72	13.91	12.55	12.07	12.58	12.03	11.80	12.27	11.65	12.45

Notes: Figures in parentheses are retransformed values of √(x+0.5)
Treatment mean with letter(s) in common are non-significant by DNMRT at 5% level of significance

From the above results, it can be deduced that the cow urine 100% + neem oil 1%, cow urine 100% + NSKE 5%, cow urine 100%, cow urine 50% + neem oil 1%, cow urine 50% + NSKE 5% and cow urine 75% were found more effective in reducing insect pests population during present investigation. However, cow urine 50%, neem oil 1%, NSKE 5%, *B. bassiana* 0.4% and cow urine 25% were found less effective in reducing the incidence of insect pests in *Bt* cotton. It can be concluded that the insect population increased in all the treatments after ten days of each sprays. Which showed reduction in efficacy of the treatments after 10 days of the application.

3.4 Impact on seed cotton yield and economics

The data on seed cotton yield recorded from various treatments as well as NICBR (Net Incremental Cost Benefit Ratio) are presented in Table 4. Maximum (2541 kg/ha) seed cotton yield was recorded in plots treated with cow urine 100% + neem oil 1% and it was at par with cow urine 100% + NSKE 5% (2502 kg/ha), cow urine 100% (2493 kg/ha), cow urine 50% + neem oil 1% (2472 kg/ha), cow urine 50% + NSKE 5% (2441 kg/ha) and cow urine 75% (2418 kg/ha). These six treatments found relatively more effective which reflected on yield of seed cotton. Among the evaluated treatments, the lowest (1955 kg/ha) yield of seed cotton was recorded in plots treated with cow urine 25% and it was at par with cow urine 50% (2081 kg/ha), neem oil 1% (2050 kg/ha), NSKE 5% (2024 kg/ha) and *B. bassiana* 0.4% (1977 kg/ha).

Table 4: Effect of different treatments on seed cotton yield and economics

Sr. No.	Treatments	Conc. (%)	Yield (kg/ha)	NICBR
T_1	Cow urine	25	1955b	1:2.73
T_2	Cow urine	50	2081b	1:3.11
T_3	Cow urine	75	2418a	1:4.92
T_4	Cow urine	100	2493a	1:4.55
T_5	Neem Seed Kernel Extract (NSKE)	5	2024b	1:3.15
T_6	Neem oil	1	2050b	1:1.30
T_7	Cow urine + Neem oil	50 + 1	2472a	1:2.67
T_8	Cow urine + Neem oil	100 + 1	2541a	1:2.32
T_9	Cow urine + NSKE	50 + 5	2441a	1:4.77
T_{10}	Cow urine + NSKE	100 + 5	2502a	1:3.71
T_{11}	*Beauveria bassiana*	0.4	1977b	1:1.95
T_{12}	Control	-	1619c	-
C. V. (%)			8.57	-

Note: Treatment mean with letter(s) in common are non-significant by DNMRT at 5% level of significance

Looking to the NICBR, the highest (1: 4.92) return was obtained from the treatment of cow urine 75% followed by cow urine 50% + NSKE 5% (1: 4.77), cow urine 100% (1: 4.55), cow urine 100% + NSKE 5% (1: 3.71), NSKE 5% (1: 3.15),cow urine 50% (1: 3.11), cow urine 25% (1: 2.73), cow urine 50% + neem oil 1% (1: 2.67), cow urine 100% + neem oil 1% (1: 2.32) and *B. bassiana* 0.4% (1: 1.95). The lowest NICBR (1: 1.30) was recorded in the treatment neem oil 1%.

The incidence of soybean girdle beetle and stem fly was significantly reduced after spraying the crop with cow urine (15-100% conc.) and resulted in a cost: benefit ratio of 1:18.9 (Gupta and Yadav, 2006) [3]. The sucking pests as well as shoot and fruit borer incidence in brinjal crop was found to be suppressed and consequently obtained the higher yields from the plot treated with cow urine at 50% concentration (Karkar *at el.*, 2014) [4]. According to Padaliya *at el.* (2018) [5] neem seed kernel extract 5 per cent and neem oil 1 per cent were found more effective in reducing thrips population infesting *Bt* cotton.

4. Conclusion

The treatments of cow urine 100% + neem oil 1%, cow urine 100% + NSKE 5%, cow urine 100%, cow urine 50% + neem oil 1%, cow urine 50% + NSKE 5% and cow urine 75% were found more effective against sucking insect pests (aphid, jassid and thrips) infesting *Bt* cotton and produced higher yield. These treatments can be recommended in organic farming for the management of sucking insect pests in *Bt* cotton looking to their effectiveness, economics and safety to the natural enemies.

5. References

1. Abbas MA. M. A. General Agriculture. Publ. Emporium, 2nd (Ed.), Pakistan, 2004.
2. Anonymous. ICAR-AICRP (Cotton) Annual Report (2016-17). ICAR-All India Co-ordinated Research Project (Cotton), Coimbatore-641 003, Tamil Nadu, pp. A, 2017, 2-5.
3. Gupta G, Yadav SR. Cow urine efficacy against stem borers and cost benefit in soybean production. International Journal of Cow Science. 2006; 2(2):15-17.
4. Karkar DB, Korat DM, Dabhi MR. Evaluation of cow urine and vermiwash against insect pests of brinjal. Karnataka Journal of Agricultural Sciences. 2014; 27(4):528-530.
5. Padaliya SR, Thumar RK, Pipaliya GK, Bhagora JK. Bio-efficacy of different botanicals against Thrips, *Scirtothrips dorsalis* Hood infesting *Bt* cotton. International Journal of Current Microbiology and Applied Sciences. 2018; 7(7):2893-2903.
6. Steel RGD, Torrie JH. Principles and procedures of statistics. Publ. McGraw Hill Book Company, New York, 1980; 137.
7. Vennila S, Ramasundram P, Sheo R, Kairon MS. Cotton IPM and its Current Status. Central Institute for Cotton Research Technical Bulletin. 2000; 8:1-13.