



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2019; 7(3): 4664-4667

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Received: 01-03-2019

Accepted: 03-04-2019

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Bioefficacy of cow urine and different types of bio-pesticide against major sucking insect pests of cowpea

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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 cowpea during 2018-19. The experiment was conducted at National Dairy Development Board (NDDDB) farm at Itola Village, Gujarat. Among the evaluated different doses and combinations of cow urine and biopesticides, cow urine 100% + neem oil 1% was found highly effective against whitefly, jassid and thrips. 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 cowpea seed 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 (530 kg/ha) yield of cowpea 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 ICBR (Incremental Cost Benefit Ratio), the highest (1: 2.10) return was obtained from the treatment of cow urine 50% + NSKE 5% and the lowest (1: 0.49) from the treatment of *Bacillus thuringiensis* 0.2%.

Keywords: Bio-efficacy, cowpea, cow urine, bio-pesticides

1. Introduction

Cowpea, *Vigna unguiculata* (Linnaeus) Walpers is considered as one of the essential crops grown in various parts of India. The importance of cowpea pods and grains as food for the people has been valued in many parts of world. It constitutes the inexpensive source of dietary protein for most of the poor people and provides good quality nutritious fodder for cattle. Cowpea seed contains about 60% carbohydrates, 22 to 28% proteins and 1.8% fat. Moreover, it is a rich source of calcium and iron (Sharma, 2000) [8]. The crop is grown as pulse, vegetable, fodder, cover crop, cash crop, medicinal and soil ameliorant crop (can fix about 88 kg N/ha), providing an inexpensive high quality protein (24%) (Bationo *et al.*, 2000) [3]. In India, total area under pulses is 25.26 million hectares with the total production of 16.47 million tones and productivity of 652 kg per hectare. In Gujarat, area covered by cowpea is 0.52 million hectares and the production 0.35 million tone with the productivity of 665 kg per hectare (Anon., 2015) [2]. As many as 21 insect pests of various groups have been recorded damaging from sprouting to maturity of the crop. The key sucking insect pests attacking the cowpea crop are aphid, *Aphis craccivora* Koch, leaf hopper, *Empoasca kerri* Pruthi, thrips, *Megaleurothrips sjostedti* Trybom and whitefly, *Bemisia tabaci* Gennadius (Prajapati *et al.*, 2009) [7]. Farmers use different kind of insecticides on cowpea to control insect-pests which are hazardous for human and animal consumption. For the benefit of humans and animals, organic and bio-control methods of insect-pest control in cowpea may be identified to decrease insecticides use and improve seed/fodder yield. Therefore, the present investigation was conducted to evaluate the bioefficacy of cow urine and different biopesticides against sucking insect pests infesting cowpea.

2. Materials and Methods

The experiment was conducted on NDDDB farm at Itola Village, Gujarat during *Summer* season 2018-19 in Randomized Block Design with three replications and twelve treatments.

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Cowpea cultivar was sown, with a spacing of 45cm between two rows and 15 cm within the rows in gross plot of 4.5x3.6m. The first spray was made at one month after sowing. Subsequently, second and third sprays were applied 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. Cowpea seed yield was recorded at maturity of crop from each treatment. The data obtained were analyzed by following standard statistical technique (Steel and Torrie, 1980) [9].

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 Whitefly

Pooled over sprays results (Table 1) revealed that cow urine 100% + neem oil 1% (0.29/leaf) was found significantly superior to all the evaluated treatments except cow urine 100% + NSKE 5% (0.31/leaf), cow urine 100% (0.36/leaf), cow urine 50% + neem oil 1% (0.40/leaf), cow urine 50% + NSKE 5% (0.44/leaf) and cow urine 75% (0.48/leaf). Lower population of whiteflies in these treatments showed more effectiveness compared to other treatments. The plots treated with cow urine 25% recorded the maximum (1.30/leaf) whitefly population and it was at par with cow urine 50% (1.06/leaf), neem oil 1% (1.11/leaf), NSKE 5% (1.19/leaf) and *B. thuringiensis* 0.2% (1.24/leaf).

Table 1: Bio-efficacy of cow urine and different type of biopesticides against whitefly infesting cowpea

Sr. No.	Treatments	Conc. (%)	No. of whitefly/ leaf days after spray										Pooled
			Before spray	First spray			Second spray			Third spray			
				5	10	15	5	10	15	5	10	15	
T ₁	Cow urine	25	1.49a (1.72)	1.41b (1.49)	1.36b (1.35)	1.40b (1.46)	1.35b (1.32)	1.30b (1.19)	1.32b (1.24)	1.32b (1.24)	1.29b (1.16)	1.35b (1.32)	1.34b (1.30)
T ₂	Cow urine	50	1.49a (1.72)	1.32b (1.24)	1.28b (1.14)	1.28b (1.14)	1.24b (1.04)	1.20b (0.94)	1.26b (1.09)	1.25b (1.06)	1.18b (0.89)	1.22b (0.99)	1.25b (1.06)
T ₃	Cow urine	75	1.53a (1.84)	1.04a (0.58)	1.00a (0.50)	1.04a (0.58)	0.99a (0.48)	0.95a (0.40)	1.01a (0.52)	0.98a (0.46)	0.93a (0.36)	0.97a (0.44)	0.99a (0.48)
T ₄	Cow urine	100	1.42a (1.52)	0.96a (0.42)	0.94a (0.38)	0.99a (0.48)	0.95a (0.40)	0.90a (0.31)	0.94a (0.38)	0.91a (0.33)	0.86a (0.24)	0.90a (0.31)	0.93a (0.36)
T ₅	Neem Seed Kernel Extract (NSKE)	5	1.55a (1.90)	1.37b (1.38)	1.33b (1.27)	1.35b (1.32)	1.31b (1.22)	1.25b (1.06)	1.29b (1.16)	1.26b (1.09)	1.23b (1.01)	1.28b (1.14)	1.30b (1.19)
T ₆	Neem oil	1	1.59a (2.03)	1.35b (1.32)	1.30b (1.19)	1.32b (1.24)	1.28b (1.14)	1.22b (0.99)	1.27b (1.11)	1.26b (1.09)	1.20b (0.94)	1.24b (1.04)	1.27b (1.11)
T ₇	Cow urine + Neem oil	50 + 1	1.47a (1.66)	0.97a (0.44)	0.94a (0.38)	1.02a (0.54)	0.97a (0.44)	0.92a (0.35)	0.97a (0.44)	0.92a (0.35)	0.90a (0.31)	0.92a (0.35)	0.95a (0.40)
T ₈	Cow urine + Neem oil	100 + 1	1.51a (1.78)	0.94a (0.38)	0.91a (0.33)	0.96a (0.42)	0.93a (0.36)	0.86a (0.24)	0.90a (0.31)	0.86a (0.24)	0.81a (0.16)	0.85a (0.22)	0.89a (0.29)
T ₉	Cow urine + NSKE	50 + 5	1.55a (1.90)	1.01a (0.52)	0.98a (0.46)	1.03a (0.56)	0.98a (0.46)	0.93a (0.36)	0.99a (0.48)	0.95a (0.40)	0.90a (0.31)	0.94a (0.38)	0.97a (0.44)
T ₁₀	Cow urine + NSKE	100 + 5	1.60a (2.06)	0.94a (0.38)	0.93a (0.36)	0.98a (0.46)	0.94a (0.38)	0.87a (0.26)	0.91a (0.33)	0.88a (0.27)	0.83a (0.19)	0.86a (0.24)	0.90a (0.31)
T ₁₁	<i>Bacillus thuringiensis</i>	0.2	1.49a (1.72)	1.40b (1.46)	1.35b (1.32)	1.37b (1.38)	1.35b (1.32)	1.27b (1.11)	1.32b (1.24)	1.29b (1.16)	1.26b (1.09)	1.30b (1.19)	1.32b (1.24)
T ₁₂	Control	-	1.52a (1.81)	1.61c (2.09)	1.63c (2.16)	1.67c (2.29)	1.67c (2.29)	1.68c (2.32)	1.69c (2.36)	1.71c (2.42)	1.71c (2.42)	1.72c (2.46)	1.68c (2.32)
C.V. %			12.47	8.86	10.50	10.48	10.44	11.07	11.13	9.09	9.45	11.00	10.26

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

It is revealed from pooled over sprays data (Table 2) that cow urine 100% + neem oil 1% (0.29/leaf), cow urine 100% + NSKE 5% (0.31/leaf), cow urine 100% (0.36/leaf), cow urine 50% + neem oil 1% (0.40/leaf), cow urine 50% + NSKE 5% (0.42/leaf) and cow urine 75% (0.46/leaf) were found superior

to the rest of treatments. The plots treated with cow urine 25% recorded the maximum (1.16/leaf) jassid population and it was at par with cow urine 50% (0.96/leaf), neem oil 1% (1.04/leaf), NSKE 5% (1.06/leaf) and *B. thuringiensis* 0.2% (1.11/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 cowpea

Treatments	Conc. (%)	No. of jassid/ leaf days after spray										Pooled
		Before spray	First spray			Second spray			Third spray			
			5	10	15	5	10	15	5	10	15	
Cow urine	25	1.70a (2.39)	1.42b (1.52)	1.37b (1.38)	1.38b (1.40)	1.31b (1.22)	1.29b (1.16)	1.29b (1.16)	1.19b (0.92)	1.19b (0.92)	1.22b (0.99)	1.29b (1.16)
Cow urine	50	1.76a (2.60)	1.34b (1.30)	1.27b (1.11)	1.29b (1.16)	1.22b (0.99)	1.18b (0.89)	1.21b (0.96)	1.14b (0.80)	1.12b (0.75)	1.17b (0.87)	1.21b (0.96)
Cow urine	75	1.66a	1.07a	1.03a	1.06a	1.00a	0.94a	0.98a	0.92a	0.89a	0.95a	0.98a

		(2.26)	(0.64)	(0.56)	(0.62)	(0.50)	(0.38)	(0.46)	(0.35)	(0.29)	(0.40)	(0.46)
Cow urine	100	1.58a (2.00)	1.00a (0.50)	0.97a (0.44)	1.00a (0.50)	0.93a (0.36)	0.90a (0.31)	0.93a (0.36)	0.87a (0.26)	0.84a (0.21)	0.90a (0.31)	0.93a (0.36)
Neem Seed Kernel Extract (NSKE)	5	1.62a (2.12)	1.37b (1.38)	1.33b (1.27)	1.35b (1.32)	1.26b (1.09)	1.23b (1.01)	1.24b (1.04)	1.17b (0.87)	1.15b (0.82)	1.18b (0.89)	1.25b (1.06)
Neem oil	1	1.68a (2.32)	1.35b (1.32)	1.29b (1.16)	1.33b (1.27)	1.24b (1.04)	1.21b (0.96)	1.23b (1.01)	1.16b (0.85)	1.15b (0.82)	1.17b (0.87)	1.24b (1.04)
Cow urine + Neem oil	50 + 1	1.68a (2.32)	1.03a (0.56)	1.00a (0.50)	1.04a (0.58)	0.95a (0.40)	0.92a (0.35)	0.97a (0.44)	0.89a (0.29)	0.86a (0.24)	0.91a (0.33)	0.95a (0.40)
Cow urine + Neem oil	100 + 1	1.72a (2.46)	0.95a (0.40)	0.94a (0.38)	0.98a (0.46)	0.89a (0.29)	0.86a (0.24)	0.88a (0.27)	0.82a (0.17)	0.81a (0.16)	0.86a (0.24)	0.89a (0.29)
Cow urine + NSKE	50 + 5	1.60a (2.06)	1.05a (0.60)	1.01a (0.52)	1.04a (0.58)	0.96a (0.42)	0.94a (0.38)	0.97a (0.44)	0.91a (0.33)	0.88a (0.27)	0.93a (0.36)	0.96a (0.42)
Cow urine + NSKE	100 + 5	1.57a (1.96)	0.97a (0.44)	0.95a (0.40)	0.99a (0.48)	0.92a (0.35)	0.87a (0.26)	0.91a (0.33)	0.84a (0.21)	0.82a (0.17)	0.87a (0.26)	0.90a (0.31)
<i>Bacillus thuringiensis</i>	0.2	1.68a (2.32)	1.40b (1.46)	1.34b (1.30)	1.36b (1.35)	1.29b (1.16)	1.25b (1.06)	1.26b (1.09)	1.18b (0.89)	1.17b (0.87)	1.20b (0.94)	1.27b (1.11)
Control	-	1.67a (2.29)	1.70c (2.39)	1.72c (2.46)	1.75c (2.56)	1.76c (2.60)	1.78c (2.67)	1.79c (2.70)	1.81c (2.78)	1.84c (2.89)	1.85c (2.92)	1.77c (2.63)
C.V. %		12.71	10.66	9.66	9.27	10.22	10.34	9.90	10.85	10.23	9.34	10.07

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

3.3 Thrips

Pooled over sprays data (Table 3) indicated that cow urine 100% + neem oil 1% (1.96/leaf) was found significantly superior to all the evaluated treatments except cow urine 100% + NSKE 5% (2.03/leaf), cow urine 100% (2.09/leaf), cow urine 50% + neem oil 1% (2.16/leaf), cow urine 50% + NSKE 5% (2.22/leaf) and cow urine 75% (2.29/leaf). The plots treated with cow urine 25% recorded the maximum (3.70/leaf) thrips population and it was at par with cow urine 50% (3.34/leaf), neem oil 1% (3.46/leaf), NSKE 5% (3.54/leaf) and *B. thuringiensis* 0.2% (3.66/leaf).

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. thuringiensis* 0.2% and cow urine 25% were found less effective in reducing the incidence of insect pests in cowpea. 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.

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

Sr. No.	Treatments	Conc. (%)	No. of thrips/ leaf days after spray										Pooled
			Before spray	First spray			Second spray			Third spray			
				5	10	15	5	10	15	5	10	15	
T ₁	Cow urine	25	2.41a (5.31)	2.16b (4.17)	2.10b (3.91)	2.15b (4.12)	2.07b (3.78)	2.03b (3.62)	2.06b (3.74)	2.01b (3.54)	1.95b (3.30)	1.98b (3.42)	2.05b (3.70)
T ₂	Cow urine	50	2.44a (5.45)	2.05b (3.70)	1.97b (3.38)	2.04b (3.66)	1.99b (3.46)	1.94b (3.26)	1.96b (3.34)	1.92b (3.19)	1.87b (3.00)	1.91b (3.15)	1.96b (3.34)
T ₃	Cow urine	75	2.37a (5.12)	1.76a (2.60)	1.69a (2.36)	1.74a (2.53)	1.69a (2.36)	1.63a (2.16)	1.66a (2.26)	1.62a (2.12)	1.60a (2.06)	1.64a (2.19)	1.67a (2.29)
T ₄	Cow urine	100	2.33a (4.93)	1.70a (2.39)	1.65a (2.22)	1.69a (2.36)	1.63a (2.16)	1.57a (1.96)	1.62a (2.12)	1.57a (1.96)	1.51a (1.78)	1.55a (1.90)	1.61a (2.09)
T ₅	Neem Seed Kernel Extract (NSKE)	5	2.36a (5.07)	2.12b (3.99)	2.04b (3.66)	2.08b (3.83)	2.03b (3.62)	1.99b (3.46)	2.01b (3.54)	1.97b (3.38)	1.92b (3.19)	1.95b (3.30)	2.01b (3.54)
T ₆	Neem oil	1	2.40a (5.26)	2.09b (3.87)	2.01b (3.54)	2.08b (3.83)	2.01b (3.54)	1.97b (3.38)	1.98b (3.42)	1.95b (3.30)	1.90b (3.11)	1.92b (3.19)	1.99b (3.46)
T ₇	Cow urine + Neem oil	50 + 1	2.40a (5.26)	1.72a (2.46)	1.66a (2.26)	1.71a (2.42)	1.66a (2.26)	1.59a (2.03)	1.64a (2.19)	1.59a (2.03)	1.53a (1.84)	1.58a (2.00)	1.63a (2.16)
T ₈	Cow urine + Neem oil	100 + 1	2.42a (5.36)	1.67a (2.29)	1.63a (2.16)	1.66a (2.26)	1.60a (2.06)	1.56a (1.93)	1.55a (1.90)	1.52a (1.81)	1.47a (1.66)	1.51a (1.78)	1.57a (1.96)
T ₉	Cow urine + NSKE	50 + 5	2.34a (4.98)	1.75a (2.56)	1.68a (2.32)	1.71a (2.42)	1.67a (2.29)	1.62a (2.12)	1.98a (3.42)	1.61a (2.09)	1.57a (1.96)	1.60a (2.06)	1.65a (2.22)
T ₁₀	Cow urine + NSKE	100 + 5	2.32a (4.88)	1.70a (2.39)	1.64a (2.19)	1.68a (2.32)	1.61a (2.09)	1.56a (1.93)	1.57a (1.96)	1.55a (1.90)	1.49a (1.72)	1.53a (1.84)	1.59a (2.03)
T ₁₁	<i>Bacillus thuringiensis</i>	0.2	2.40a (5.26)	2.15b (4.12)	2.07b (3.78)	2.14b (4.08)	2.05b (3.70)	2.03b (3.62)	2.04b (3.66)	2.00b (3.50)	1.93b (3.22)	1.95b (3.30)	2.04b (3.66)
T ₁₂	Control	-	2.45a (5.50)	2.45c (5.50)	2.47c (5.60)	2.47c (5.60)	2.49c (5.70)	2.50c (5.75)	2.51c (5.80)	2.51c (5.80)	2.53c (5.90)	2.54c (5.95)	2.50c (5.75)
	C.V. %		8.39	8.01	8.07	8.68	8.76	8.73	9.03	8.51	8.07	8.22	8.46

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

3.4 Impact on seed cowpea yield and economics

The data on cowpea seed yield recorded from various treatments as well as NICBR (Net Incremental Cost Benefit Ratio) are presented in Table 4. Maximum (698 kg/ha) cowpea seed yield was recorded in plots treated with cow urine 100% + neem oil 1% and it was at par with cow urine 100% + NSKE 5% (684 kg/ha), cow urine 100% (673 kg/ha), cow urine 50% + neem oil 1% (666 kg/ha), cow urine 50% + NSKE 5% (656 kg/ha) and cow urine 75% (641 kg/ha). These six treatments found relatively more effective which reflected on yield of cowpea. Among the tested treatments, the lowest (530 kg/ha) yield of cowpea was recorded in plots treated with cow urine 25% and it was at par with cow urine 50% (561 kg/ha), neem oil 1% (554 kg/ha), NSKE 5% (546 kg/ha) and *B. thuringiensis* 0.2% (539 kg/ha).

Looking to the ICBR (Incremental Cost Benefit Ratio), the highest (1: 2.10) return obtained from the treatment of cow urine 50% + NSKE 5% followed by cow urine 75% (1: 2.06), cow urine 100% (1: 2.06), cow urine 100% + NSKE 5% (1: 1.81), NSKE 5% (1: 1.45), cow urine 50% (1: 1.45), cow urine 50% + neem oil 1% (1: 1.35), cow urine 25% (1: 1.31), cow urine 100% + neem oil 1% (1: 1.30) and neem oil 1% (1: 0.81). The lowest ICBR (1: 0.49) was recorded in the treatment *B. thuringiensis* 0.2%.

Bioassay of cow urine when evaluated on the cowpea aphid, *A. craccivora* Koch found as effective as garlic and imidacloprid 0.25% (Tesfaye and Gautam, 2003) [10]. 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) [4]. The results revealed that population of sucking pests, viz., jassid, mirid bug and whitefly was decreased significantly in the treatment of Neem oil (1%), Neem seed kernel extract (3%), Neem leaf extract (3%) and cow urine (3%) as compared to untreated control in sesame crop (Ahirwar *et al.*, 2010) [1]. 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 50% concentration (Karkar *et al.*, 2014) [5]. According to Padaliya *et al.* (2018) [6] neem seed kernel extract 5 per cent and neem oil 1 per cent were more effective in reducing thrips population infesting *Bt* cotton.

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

Sr. No.	Treatments	Conc. (%)	Yield (kg/ha)	ICBR
T ₁	Cow urine	25	530b	1:1.31
T ₂	Cow urine	50	561b	1:1.45
T ₃	Cow urine	75	641a	1:2.06
T ₄	Cow urine	100	673a	1:2.06
T ₅	Neem Seed Kernel Extract (NSKE)	5	546b	1:1.45
T ₆	Neem oil	1	554b	1:0.81
T ₇	Cow urine + Neem oil	50 + 1	666a	1:1.35
T ₈	Cow urine + Neem oil	100 + 1	698a	1:1.30
T ₉	Cow urine + NSKE	50 + 5	656a	1:2.10
T ₁₀	Cow urine + NSKE	100 + 5	684a	1:1.81
T ₁₁	<i>Bacillus thuringiensis</i>	0.2	539b	1:0.49
T ₁₂	Control	-	448c	-
C. V. (%)			8.48	-

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

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 (whitefly, jassid and thrips) infesting cowpea and produced higher yield. These treatments can be recommended in organic farming for the management of sucking insect pests in cowpea looking to their effectiveness, economics and safety to the natural enemies.

5. References

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