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CC PatelNational Dairy Development
Board, Anand, Gujarat, India**Digvijay Singh**National Dairy Development
Board, Anand, Gujarat, India**Vinod Uikey**National Dairy Development
Board, Anand, Gujarat, India**Alka Choudhary**National Dairy Development
Board, Anand, Gujarat, India**Ashish Dindod**National Dairy Development
Board, Anand, Gujarat, India**SR Padaliya**National Dairy Development
Board, Anand, Gujarat, India**V Sridhar**National Dairy Development
Board, Anand, Gujarat, India**Corresponding Author:****CC Patel**National Dairy Development
Board, Anand, Gujarat, India

Organic pest management in moringa, maize and sorghum fodder crops

CC Patel, Digvijay Singh, Vinod Uikey, Alka Choudhary, Ashish Dindod, SR Padaliya and V Sridhar

Abstract

Bovine urine was evaluated at 75 percent in combination with neem oil 1% and NSKE 5% for its field bio-efficacy against insect pests of moringa and maize during 2019-20. The experiments were conducted at Forage Research Center, Itola farm (Gujarat). Among evaluated different bovine urine, desi cow urine 75% + neem oil 1% was found most effective against whiteflies followed by buffalo urine 75% + neem oil 1%, cross breed cow urine 75% + neem oil 1% and neem oil 1%. In respect to green fodder yield buffalo urine 75% + neem oil 1% and cross breed cow urine 75% + neem oil 1% also registered more green fodder yield as compared to other treatments. The treatment of buffalo urine 75% + neem oil 1% registered maximum ICBR (1:24.37) followed by crossbreed cow urine 76% + neem oil 1% (1:20.60), neem seed kernel extract 5% (1:19.35), desi cow urine 75% + neem oil 1% (1:15.68), buffalo urine 75% + NSKE 5% (1:12.08), desi cow urine 75% + NSKE 5% (1:10.22) and crossbreed cow urine 75% + NSKE 5% (1:10.07). Thus, it is clearly indicated that bovine urines in combination with neem oil were found most effective in managing whiteflies and ultimately increased the fodder yield of moringa. Considering various treatments, time interval and sprays, the treatment of buffalo urine 75% + Neem oil 1% registered lowest infestation of twigs by bud worm which also reflected on green fodder and dry matter yield. In maize, minimum infestation (86%) of fall armyworm was found in the treatment of buffalo urine 75% + neem oil 1% (86%) followed by cross breed cow urine 75% + neem oil 1% (80%), cross breed cow urine 75% + NSKE 5% (88%) and buffalo urine 75% + NSKE 5% (88%). Lower (67%) stem borer infestation in sorghum was found in the treatment of buffalo urine 75% + neem oil 1%. It was reflected on growth parameters and yield.

Keywords: Bio-efficacy, moringa, maize, bovine urine, bio-pesticides

Introduction

Among various vegetable crops, drumstick, *Moringa oleifera* Lamarck is an important vegetable crop rich in minerals and vitamins. It belongs to the family Moringaceae (Keay, 1989) ^[1]. Leaves, pods and flowers are used as vegetable which have tremendous nutritional and medicinal values. Multifarious uses of drumstick trees that include alley cropping, animal forage, biogas, domestic cleaning agent, blue dye, fencing, fertilizer, foliar nutrient, green manure, gum, honey and sugar cane juice clarifier, honey, medicine, ornamental plantings, biopesticides, pulp, rope, tannin for tanning hides, water purification *etc.* (Fuglie, 2000) ^[2]. India is the largest producer of drumstick with an area of 93,917 acres and production of 1,30,00,00 tons. Andhra Pradesh is the largest producer followed by Karnataka and Tamil Nadu (<https://discuss.farmnest.com>). There are number of biotic stresses for *M. oleifera*, which affects its production qualitatively and quantitatively. Insect pests are the main limiting factors. Butani and Verma (1981) ^[3] reported twenty eight different insect species and two species of mites from India infesting various parts of drumstick trees. Among them, moringa budworm [*Noorda blitealis* Walker (Lepidoptera)] and whitefly, *Bemisia tabaci* G. are of major importance. Thumar *et al.* (2017) ^[4] from Gujarat reported that bud worm, *N. blitealis* caused damage to leaves as well as pods of drumstick in Middle Gujarat. Maize suffers from severe insect pest damage. Maize fall armyworm, *Spodoptera frugiperda* Smith is one of the important pests causing severe damage and yield losses. The use of bio-rational products such as cow-urine and neem products is one of the alternatives of chemical insecticides. Therefore, the present investigation was conducted to evaluate the bio efficacy of cow urine and different biopesticides against insect pests infesting moringa and maize fodder crop.

Materials and Methods

The field experiments were conducted to check the effects of "Bio-efficacy of bovine urine &

different types of bio-pesticides against major insect pests in moringa fodder & seed production crops” two experiments were taken up during *Summer* season 2020 in Completely Randomized Design (seed crop) and Randomized Block Design (fodder crop) with three replications and fifteen treatments: First experiment on a new crop of moringa was sown at FRC, Itola to estimate fodder yield and growth parameters. For second experiment 45 plants were selected from the orchards grown for seed purpose. Moringa was sown, 30 × 30 cm for fodder and 4 × 2.5 m for seed crop. The required plants having equal growth, age and canopy were selected. All the recommended agronomical practices were followed during experimentation. The first spray was made at initiation of the pest in the month of February for fodder moringa and August for seed crop. From each plant five shoots each of 15 cm were selected randomly and damaged shoots were counted for seed purpose. Five leaves from each plant were selected for counting whitefly population and such five plants were selected from each treatment. Three replications were maintained for the experiment. First spray was applied at the initiation of the whiteflies population. Subsequent sprays were applied at 15 days interval continuously up to end September as per requirement. In case of seed crop for recording observations, one plant was considered as one repetition. From each plant five shoots, each of 15 cm were selected randomly and damaged shoots were counted. The observations were recorded prior to the first spray and subsequently on 7 and 15 days after each spray. Effect of treatments on green fodder yield and their growth parameters were recorded. Farm yard manure was applied for meeting requirement of the crop for nitrogen, phosphorus, and potash. No chemical fertilizers were used for meeting any nutrient requirement. FYM was the only source of nutrient for experimental work. Observations on yield attributes of moringa for green fodder yield were recorded like plant height, no. of branches, leaf stem ratio, dry matter yield and dry matter content from fodder crop. In moringa fodder crop only one cut was taken. At harvest, observations were recorded and green fodder samples were taken for estimation of dry matter content. In seed crop of moringa, green fodder and dry matter were recorded. For each treatment, 3 fruit bearing moringa trees were selected. To record the incidence of stem borer in maize and sorghum, ten plants were selected randomly from net plot area of each treatment and observations were recorded on number of healthy and infested plants before first spray and at the harvest. The data obtained were analyzed by following standard statistical technique (Steel and Torrie, 1980) [5].

Results and Discussion

An experiment was conducted at Itola, Gujarat farm during 2020 to evaluate the bio-efficacy of bovine urine and different types of bio pesticides against moringa green fodder yield, and growth parameters.

Moringa growth parameters and yield

Plant height

The observations on moringa plant height recorded from various treatments as well as control during study are presented in Table 1. Moringa plant height was found maximum (138 cm) in plots treated with crossbreed cow urine 75%+ neem oil 1% and it was at par with buffalo urine 75% + neem oil 1% (136 cm), desi cow urine 75% + NSKE 5% (129 cm), desi cow urine 75% + neem oil 1% (127 cm), buffalo urine 75% + NSKE 5% (124 cm), neem oil 1% (124 cm), Gobardhan (foliar) 1% + PROM (basal application) (50 kg per acre) (123 cm) and cross breed cow urine 75% + NSKE 5% (121 cm). Thus, It is concluded that all the treatments were found effective in increasing plant height except *Bacillus thuringiensis*, crossbred cow urine 75%,neem seed kernel extract 5%, desi cow urine 75% and desi cow urine 75%+ green chilli extract 2%.

Plant/m Row

On the bases of data presented in table 1, it was observed that all the treatments remained at par with each other. However, maximum (2.46) plants/m row were observed in the treatment of Gobardhan (foliar) 1% + PROM (basal application) (50kg per acre) and *Bacillus thuringiensis* 0.2% and minimum plants/m were recorded from treatments of desi cow urine 75%, buffalo urine 75%, neem oil 1%, desi cow urine 75% + neem oil 1%, crossbreed cow urine 75% + neem oil 1%, buffalo urine 75% + neem oil 1%, desi cow urine 75% + green chilli extract 2%, cross breed cow urine 75%+ NSKE 5% and control (2.26).

Number of branches/plant

The data presented in the table 1 revealed that the Gobardhan (foliar) 1% + PROM (basal application) (50 kg per acre), buffalo urine 75% + neem oil 1% and crossbreed cow urine 75% + neem oil 1% were found significantly superior as these treatments recorded significantly more number of branches/plant (15, 14 and 14/plant, respectively). Treatments of neem oil 1% (13/plant), cross breed cow urine 75%+ NSKE 5% (13/plant), buffalo urine 75% (12/plant), desi cow urine 75% + neem oil 1% (12.66/plant), desi cow urine 75% + green chilli extract 2% (12.66) and cross breed cow urine 75% + NSKE 5% (12.66) showed moderate number of branches per plant.

Table 1: Evaluation of bovine urine and different types of bio pesticides against moringa growth parameters and yield.

Tr. No.	Treatments	Plant height (cm)	Plant/m row	No branches/plant	Leaf stem ratio	Green fodder yield (t/ha)	Dry matter yield (t/ha)	GFY % increase over control	DMY % increase over control	DMY %
T ₁	Desi cow urine 75%	109	2.26	12	0.28	13.28	2.66	-6	-14	20
T ₂	Crossbreed cow urine 75%	103	2.40	12	0.54	15.03	3.00	5	-3	20
T ₃	Buffalo urine 75%	106	2.26	12	0.48	13.22	2.91	-6	-6	22
T ₄	Neem oil 1%	124	2.26	13	0.35	15.46	3.09	9	-0.3	20
T ₅	Gobardhan (Foliar) 1% PROM (Basal application) (50kg per acre)	123	2.46	15	0.33	30.37	6.07	114	95	20
T ₆	<i>Bacillus thuringiensis</i> 0.2%	87	2.46	11	0.41	18.00	3.96	27	28	22
T ₇	Neem Seed Kernel Extract (NSKE) 5%	103	2.40	12	0.38	25.22	6.05	78	95	24
T ₈	Desi cow urine 75% + Neem oil 1%	127	2.26	12	0.34	26.91	5.92	90	91	22
T ₉	Crossbreed cow urine 75%+ Neem oil 1%	138	2.26	14	0.32	30.90	6.80	118	119	22
T ₁₀	Buffalo urine 75% + Neem oil 1%	136	2.26	14	0.29	33.96	6.79	140	119	20
T ₁₁	Desi cow urine 75% + Green chilli extract 2%	110	2.26	12	0.40	16.56	3.64	17	17	22

T ₁₂	Desi cow urine 75% + NSKE 5%	129	2.33	12	0.34	21.07	3.98	49	28	19
T ₁₃	Cross breed cow urine 75%+ NSKE 5%	121	2.26	13	0.37	20.98	5.04	48	63	24
T ₁₄	Buffalo urine 75% + NSKE 5%	124	2.40	12	0.44	22.32	5.36	57	73	24
T ₁₅	Control	95	2.26	10	0.46	14.19	3.10	-	-	22
C.D. at 5 %		25.84	NS	2.32	0.19	6.91	2.0	-	-	
C. V. %		13.03	6.18	10.8	19.6	20.1	8.2	-	-	

NS- Non-Significant

Leaf Stem Ratio

The maximum (0.54) leaf stem ratio was observed in the treatment of crossbreed cow urine 75% which remained at par with buffalo urine 75% (0.48), control (0.46), buffalo urine 75% + NSKE 5% (0.44), *Bacillus thuringiensis* 0.2% (0.41), desi cow urine 75% + green chilli extract 2% (0.40), neem seed kernel extract (NSKE) 5% (0.38), cross breed cow urine 75% + NSKE 5% (0.37) and neem oil 1% (0.35).

Green Fodder Yield (Percent increase over control)

Maximum percent increase over control for GFY (140) was found in the treatment of buffalo urine 75% + Neem oil 1% followed by cross breed cow urine 75% + neem oil 1% and Gobardhan 1% + PROM basal application.

Dry Matter Yield (Percent increase over control)

Increase over control in respect to DMY was found maximum (119) in the treatment of buffalo urine 75% + neem oil 1% followed by crossbreed cow urine 75% + neem oil 1%, Gobardhan 1% and NSKE 5%.

Bio-efficacy against whitefly

The population of whitefly was homogeneous in all the treatments before spray as treatment difference was non-significant. All the evaluated treatments were significantly superior to control up to 15 days of spray in controlling the white flies. (Table 2)

Average whitefly population of three observations was found minimum (1.16) in the treatment of desi cow urine 75%+ neem oil 1% followed by NSKE 5% and *Bacillus thuringiensis* 0.2%. Maximum whitefly population (3.08) was found in the control plots.

Table 2: Evaluation of bovine urine and different types of bio pesticides against whiteflies in moringa fodder crop.

Tr. No.	Treatments	Before	No. of whitefly/ leaf days after spray			Average no of whitefly/leaf	Whitefly population (%) decrease over control	ICBR
			1 st spray		2 nd spray			
			7 th	15 th	7 th			
T ₁	Desi cow urine 75%	3.00	1.15	2.37	1.91	1.81	41	1:-1.96
T ₂	Crossbreed cow urine 75%	3.02	1.33	1.82	1.26	1.47	52	1:1.8
T ₃	Buffalo urine 75%	2.85	1.33	2.08	1.26	1.56	49	1:-2.08
T ₄	Neem oil 1%	2.90	1.55	2.28	1.00	1.61	48	1:1.93
T ₅	Gobardhan (Foliar)1% PROM (Basal application) (50kg per acre)	2.70	1.44	2.44	1.20	1.69	45	1:4.18
T ₆	<i>Bacillus thuringiensis</i> 0.2%	2.66	1.13	1.95	1.28	1.45	52	1:3.07
T ₇	Neem Seed Kernel Extract (NSKE) 5%	2.93	1.66	1.48	1.20	1.45	52	1:19.35
T ₈	Desi cow urine 75% + Neem oil 1%	2.91	0.71	1.88	0.88	1.16	62	1:15.68
T ₉	Crossbreed cow urine 75%+ Neem oil 1%	3.22	1.13	2.86	1.09	1.69	44	1:20.60
T ₁₀	Buffalo urine 75% + Neem oil 1%	3.49	1.47	2.31	1.00	1.59	48	1:24.37
T ₁₁	Desi cow urine 75% + Green chilli extract 2%	2.71	1.24	1.84	1.58	1.55	50	1:3.59
T ₁₂	Desi cow urine 75% + NSKE 5%	2.84	1.47	2.66	2.40	2.18	29	1:10.22
T ₁₃	Cross breed cow urine 75%+ NSKE 5%	2.80	1.20	2.35	1.35	1.63	47	1:10.07
T ₁₄	Buffalo urine 75% + NSKE 5%	2.80	1.51	2.08	1.33	1.64	47	1:12.08
T ₁₅	Control	2.82	1.82	2.86	4.57	3.08	-	-
C.D. at 5 %		NS	0.54	1.27	1.22	-	-	-
C. V. %		11.78	14.10	14.23	20.10	-	-	-

Economics

The treatment of buffalo urine 75% + neem oil 1% registered maximum ICBR (1:24.37) followed by crossbreed cow urine 75% + neem oil 1% (1:20.60), neem seed kernel extract 5% (1:19.35), desi cow urine 75% + neem oil 1% (1:15.68), buffalo urine 75% + NSKE 5% (1:12.08), desi cow urine 75% + NSKE 5% (1:10.22) and crossbreed cow urine 75% +

NSKE 5% (1:10.07).

Bio-efficacy against moringa bud worm

The twig infestation (%) was homogeneous in all the treatments before spray as treatment difference was non-significant. All the evaluated treatments were significantly superior to control up to 15 days of spray (Table 3).

Table 3: Evaluation of bovine urine and different types of bio pesticides against bud worm in moringa seed crop.

Tr. No.	Treatments	Infested twig (%) days after spray						Fodder yield (t/ha)	Dry matter yield (t/ha)	GFY% increase over control	DMY % Increase over control	
		Before	1 st spray		2 nd spray		3 rd spray					
			7 th	15 th	7 th	15 th	7 th					15 th
T ₁	Desi cow urine 75%	62	58	50	31	24	13	0	0.96	0.16	104	60
T ₂	Crossbreed cow urine 75%	61	59	58	33	24	10	0	1.02	0.23	117	130
T ₃	Buffalo urine 75%	62	58	55	35	24	10	0	1.06	0.2	125	100
T ₄	Neem oil 1%	63	53	47	33	17	10	0	0.83	0.17	76	70
T ₅	Gobardhan (Foliar)1% & PROM(Basal	63	57	53	38	25	13	0	1.07	0.14	127	140

	application) (50kg per acre)											
T ₆	<i>Bacillus thuringiensis</i> 0.2%	60	55	58	38	31	10	0	0.55	0.1	17	100
T ₇	Neem Seed Kernel Extract (NSKE) 5%	61	57	59	38	25	7	0	0.64	0.15	36	50
T ₈	Desi cow urine 75% + Neem oil 1%	61	56	49	28	21	11	0	0.98	0.21	108	110
T ₉	Crossbreed cow urine 75% + Neem oil 1%	62	57	52	24	25	10	0	1.01	0.25	114	150
T ₁₀	Buffalo urine 75% + Neem oil 1%	61	54	48	24	19	9	0	1.07	0.23	127	130
T ₁₁	Desi cow urine 75% + Green chilli extract 2%	59	58	60	33	27	13	0	0.64	0.15	36	50
T ₁₂	Desi cow urine 75% + NSKE 5%	61	54	57	31	29	10	0	0.78	0.08	65	-20
T ₁₃	Cross breed cow urine 75% + NSKE 5%	60	55	57	28	29	12	0	0.8	0.13	70	30
T ₁₄	Buffalo urine 75% + NSKE 5%	59	57	54	25	21	10	0	0.93	0.18	97	80
T ₁₅	Control	60	58	63	44	31	13	8	0.47	0.1	-	-
	C.D. at 5 %	NS	4.54	5.44	7.16	8.29	3.53	-	0.36	0.08		

NS: Non-Significant

First spray

On 7th day after spray

Seven days after first spray, the lowest (53 %) twig infestation was found in plots treated with neem oil 1% and it was at par with buffalo urine 75% + neem oil 1%, desi cow urine 75% + NSKE 5%, *Bacillus thuringiensis* 0.2%, cross breed cow urine 75% + NSKE 5%, desi cow urine 75% + neem oil 1%, Gobardhan (foliar) 1% + PROM (basal application) (50kg per acre), neem seed kernel extract (NSKE) 5%, buffalo urine 75% + NSKE 5% and crossbreed cow urine 75% + neem oil 1% by showing infested twig of 54 % to 57%. These ten treatments were found significantly superior to rest of the treatments.

On 15th Day

The treatment of neem oil 1% showed maximum efficacy by showing lowest twig infestation (47 %). However, it was at par with buffalo urine 75% + neem oil 1% (48 %), desi cow urine 75% + neem oil 1% (49 %), desi cow urine 75% (50 %) and crossbreed cow urine 75% + neem oil 1% (52 %) after fifteen days of spray. While, treatments of Gobardhan (foliar) 1% + PROM (basal application) (50kg per acre), buffalo urine 75% + NSKE 5%, buffalo urine 75%, cross breed cow urine 75% + NSKE 5%, and desi cow urine 75% + NSKE 5% (53 %, 54 %, 55 %, 57 % and 57 %, respectively) indicated moderate twig infestation. The treatment of desi cow urine 75% + green chilli extract 2% showed the maximum (60 %) twig infestation and it was at par with neem seed kernel extract (NSKE) 5% (59 %), *Bacillus thuringiensis* 0.2% (58 %) and crossbreed cow urine 75% (58 %).

Second spray

On 7th day

Seven days after first spray, the lowest (24 %) twig infestation was found in plots treated with buffalo urine 75 % + neem oil 1% and it was at par with crossbreed cow urine 75 % + neem oil 1% (24 %), buffalo urine 75% + NSKE 5% (25 %), cross breed cow urine 75% + NSKE 5% (28 %), desi cow urine 75% + neem oil 1% (28 %) and desi cow urine 75% (31 %). Treatments of desi cow urine 75% + NSKE 5% (31 %), neem oil 1% (33 %), crossbreed cow urine 75% (33 %), desi cow urine 75% + green chilli extract 2% (33 %) and buffalo urine 75% (35 %) were found moderately effective for reducing twig infestation.

On 15th Day

The treatment of neem oil 1% showed maximum efficacy by showing lowest twig infestation (17 %). However, it remained at par with buffalo urine 75 % + neem oil 1% (19 %), desi

cow urine 75% + neem oil 1% (21 %), buffalo urine 75% + NSKE 5% (21 %), crossbreed cow urine 75% (24 %), desi cow urine 75% (24 %), buffalo urine 75% (24 %), Gobardhan (foliar) 1% + PROM (basal application) (50kg per acre) (25 %), neem seed kernel extract (NSKE) 5% (25 %) and crossbreed cow urine 75% + neem oil 1% (25 %) after fifteen days of spray.

Third spray

On 7th day

Data presented in table 3 showed maximum efficacy of NSKE 5 % by showing lowest twig infestation (7%). However, it was at par with buffalo urine 75 % + Neem oil 1%. The remaining treatments were at par with each other. Maximum twig infestation 13 % was found in control plots.

On 15th day

The infestation of leaf eating caterpillar was disappeared in all the bio pesticides treatments except control.

Green Fodder Yield (Percent increase over control)

The treatment of buffalo urine 75% + neem oil 1% and gobardhan 1% showed maximum GFY over control (127) followed by buffalo urine 75%(117) and cross breed cow urine 75%+neem oil 1%(114).

Dry matter yield (Percent increase over control)

Maximum DMY over control (150) found in the treatment of cross breed cow urine 75% + neem oil 1% followed by Gobardhan 1% (140), crossbreed cow urine 75% (130) and buffalo urine 75% + neem oil 1% (130). Considering various treatments, time interval and sprays, the treatment of buffalo urine 75 % + Neem oil 1% registered lowest infestation of twigs by leaf eating caterpillar which also reflected on green fodder and dry matter yield.

Maize

Plant Height

Maximum plant height (1.57 m) was found in the treatment of *Bacillus thuringiensis* 0.2% and it was at par with treatment of number desi cow urine 75 %, Neem oil 1%, Gobardhan (foliar) 1% and PROM (Basal), Neem Seed Kernel Extract (NSKE) 5%, desi cow urine 75% + Neem oil 1%, Crossbreed cow urine 75 % + Neem oil 1%, desi cow urine 75% + Green chilli extract 2%, Cross breed cow urine 75% + NSKE 5% and Control. In respect to plant height, treatment of NSKE 5% and desi cow urine 75% + Neem oil 1% was found second best treatments (Table 4).

Table 4: Evaluation of bovine urine and different types of bio pesticide in maize against fall armyworm

Tr. No.	Treatments	Yield Parameters					Per cent plants infested	
		Plant height (m)	Number of leaves per plant	No of cobs per six plants	Green fodder yield (t/ha)	Dry matter (t/ha)	Before spray	at harvest
1	Desi cow urine 75%	1.41	11.67	2	20.05	6.69	90	95
2	Crossbreed cow urine 75%	1.34	9.89	4	19.93	6.98	70	95
3	Buffalo urine 75%	1.34	10.39	4	19.95	7.38	90	90
4	Neem oil 1%	1.43	9.89	5	21.81	8.27	90	95
5	Gobardhan (Foliar) 1% PROM(Basal application) (50kg per acre)	1.39	10.00	4	20.08	7.57	90	95
6	<i>Bacillus thuringiensis</i> 0.2%	1.57	9.44	5	21.71	7.99	90	90
7	Neem Seed Kernel Extract (NSKE) 5%	1.46	10.00	5	20.21	7.50	85	90
8	Desi cow urine 75% + Neem oil 1%	1.46	9.78	5	21.73	7.94	85	90
9	Crossbreed cow urine 75% + Neem oil 1%	1.39	9.67	4	21.44	7.97	75	88
10	Buffalo urine 75% + Neem oil 1%	1.38	9.83	5	21.96	8.82	70	86
11	Desi cow urine 75% + Green chilli extract 2%	1.42	9.83	5	21.10	8.94	70	90
12	Desi cow urine 75% + NSKE 5%	1.24	9.89	5	19.62	7.74	75	90
13	Cross breed cow urine 75% + NSKE 5%	1.42	10.61	6	20.46	7.27	70	88
14	Buffalo urine 75% + NSKE 5%	1.31	10.11	4	19.10	7.16	73	88
15	Control	1.42	10.44	4	20.21	7.38	87	91
	CD at 5%	0.20	1.17	2.21	2.63	NS	NS	NS
	CV%	8.31	6.90	30.38	7.63	17.78	11.80	6.40

No. of Cobs

Maximum number of cobs per six plants was found in the treatment of cross breed cow urine 75% + NSKE 5%. However, it was at par with rest of the treatments except treatment of desi cow urine 75%.

Green Fodder Yield (GFY)

Maximum green fodder yield (21.96 t/ha) was found in the treatment of buffalo urine 75% + neem oil 1%. Neem oil 1% was found next best treatment by registering GFY of 21.81 t/ha. The treatment of desi cow urine 75% + neem oil 1% was found third best treatment which registered GFY of 21.73 t/ha. However, this treatment was found at par with rest of the treatments.

Dry Matter Yield (DMY)

All the treatments were at par with each other in respect to DMY. However, maximum (DMY) was found in the treatment of desi cow urine 75% + green chilli extract 2% followed by buffalo urine 75% + neem oil 1%.

Fall armyworm infestation**Before spray**

The effect of different treatments was non- significant. However, infestation of fall armyworm was minimum (70%) in the treatment of buffalo urine 75% + neem oil 1%, desi cow urine 75% + green chili extract 2% and cross breed cow urine 75% + NSKE 5% followed by buffalo urine 75% + NSKE 5%.

At harvest

The effect of different treatments on fall armyworm infestation was found non-significant. However minimum infestation (86%) of stem borer was found in the treatment of buffalo urine 75% + neem oil 1% (86%) followed by cross

breed cow urine 75% + neem oil 1% (80%), cross breed cow urine 75% + NSKE 5% (88%) and buffalo urine 75% + NSKE 5% (88%).

Sorghum**Plant height**

Maximum plant height was recorded (119 cm) in plots treated with neem seed kernel extract (NSKE) 5% and it was at par with crossbreed cow urine 75% (104 cm), desi cow urine 75% + NSKE 5% (104 cm), Gobardhan (foliar) 1% + PROM (basal application) (50kg per acre) (104 cm), desi cow urine 75% (102 cm), buffalo urine 75% (102 cm), buffalo urine 75% + neem oil 1% (101 cm), desi cow urine 75% + green chilli extract 2% (100 cm), buffalo urine 75% + NSKE 5% (99 cm), desi cow urine 75% + neem oil 1% (99 cm), cross breed cow urine 75% + NSKE 5% (99 cm) and crossbreed cow urine 75% + neem oil 1% (97.33).

No. of leaves per plant

On the bases of data presented in table 5, it was observed that all the treatments remained at par with each other. However, maximum (9.00/plant) no. of leaves per plant were observed in treatment of crossbreed cow urine 75%.

Green Fodder Yield (t/ha)

Data presented in table 5 showed that maximum (11.43 t/ha) green fodder yield was recorded in plots treated with desi cow urine 75% + NSKE 5% and it was at par with buffalo urine 75% + neem oil 1% (10.35 t/ha), desi cow urine 75% + neem oil 1% (9.96 t/ha), crossbreed cow urine 75% + neem oil 1% (9.75 t/ha), Gobardhan (foliar) 1% + PROM (basal application) (50kg per acre) (9.52 t/ha), crossbreed cow urine 75% (9.26 t/ha), desi cow urine 75% (9.18 t/ha), *Bacillus thuringiensis* 0.2% (9.03 t/ha) and buffalo urine 75% (8.96 t/ha).

Dry matter yield (t/ha)

Data presented in table 5 showed that maximum (4.10 t/ha) dry matter yield was recorded in plots treated with desi cow urine 75% + NSKE 5% which remained at par with buffalo urine 75% + neem oil 1% (3.67 t/ha).

Before spray (%) plant infested by stem borer

The data presented in table 5, showed non-significant among all the treatments to stem borer infestation indicating no any effect of treatments on stem borer.

Percent plants infested at harvest

On the bases of data presented in table 5, it was observed that all the treatments were found non-significant to stem borer infestation indicating no any effect of treatments on stem borer.

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 (Patel *et. al.*, 2019)^[6].

Table 5: Evaluation of bovine urine and different types of bio pesticide in sorghum against stem borer

Tr. No.	Treatments	Yield Parameters				Per cent plants infested	
		Plant height (m)	Number of leaves per plant	Green fodder yield (t/ha)	Dry matter (t/ha)	Before spray	at harvest
1	Desi cow urine 75%	102	8.00	9.18	2.62	60	70
2	Crossbreed cow urine 75%	104	9.00	9.26	1.99	63	70
3	Buffalo urine 75%	102	7.00	8.96	1.87	67	73
4	Neem oil 1%	96	7.00	8.33	2.69	67	73
5	Gobardhan (Foliar) 1% PROM(Basal application) (50kg per acre)	104	8.00	9.52	2.64	63	73
6	<i>Bacillus thuringiensis</i> 0.2%	96	8.00	9.03	2.35	67	73
7	Neem Seed Kernel Extract (NSKE) 5%	119	8.00	8.26	2.90	70	73
8	Desi cow urine 75% + Neem oil 1%	99	6.00	9.96	3.16	73	80
9	Crossbreed cow urine 75%+ Neem oil 1%	97	8.00	9.75	3.25	73	77
10	Buffalo urine 75% + Neem oil 1%	101	8.00	10.35	3.67	57	67
11	Desi cow urine 75% + Green chilli extract 2%	100	7.00	7.13	2.01	70	73
12	Desi cow urine 75% + NSKE 5%	104	8.00	11.43	4.10	63	80
13	Cross breed cow urine 75%+ NSKE 5%	99	8.00	8.63	3.06	70	83
14	Buffalo urine 75% + NSKE 5%	99	7.00	8.31	3.08	63	70
15	Control	89	7.00	7.05	2.14	73	76
CD at 5%		23.61	1.88	2.67	0.80	NS	NS
CV%		13.96	14.71	17.73	17.45	15.62	14.96

Conclusion

Moringa whitefly, *Bemisia tabaci* G. were controlled by applying desi cow urine 75% + neem oil 1%, buffalo urine 75% + neem oil 1% or cross breed cow urine 75% + neem oil 1%. These treatments also increased green fodder and dry matter yield. The treatments of buffalo urine 75% + neem oil 1% and neem seed kernel extract 5% were found effective for the control of moringa bud worm. Minimum maize fall armyworm infestation was found in the treatment of buffalo urine 75% + neem oil 1% followed by cross breed cow urine 75% + neem oil 1%. In sorghum, lowest stem borer infestation buffalo cow urine 75% + neem oil 1% and it was reflected on growth parameters and yield.

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