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To study the bio-efficacy of natural compounds against *Helicoverpa armigera* in tomato

Shalendra Pratap Singh and Ramakant Dwivedi

Abstract
A field experiment was conducted at Chandra shekhar azad university of agriculture and technology Kanpur (U.P) on tomato crop to study the bio-efficacy of natural compounds against *H. armigera* in tomato during rabi season 2018-19 and 2019-20. Cow urine + *neem* leaf extract 5% @ 50 ml/l. as spray on standing crop with 38.01 population reduction over control proved best among all treatments by reducing mean number of larvae to the tune of 0.76. The second best treatment applied to the tomato crop on standing crop as spray form was *neem* leaf extract 5% @ 50 ml/l, with 35.02 population reduction over control with mean number of larvae i.e. 0.80. The third best treatment spraying to the crop was cow urine + tobacco extract 5% @ 50 ml/l, with 26.47 population reduction over control with mean number of larvae 0.91 which was statistically at par with cow urine + moringa leaf extract 5% @ 50 ml/l, with 25.66 population reduction over control with mean 0.92 larvae, moringa leaf extract 5% @ 50 ml/l, with 25.34 population reduction over control with mean number of larvae 0.92 and tobacco extract 5% @ 50 ml/l. with 24.29 population reduction over control with mean 0.93 larvae. Treatment cow dung ash as splitting form on standing crop was found most inferior among all the treatments with 19.37 population reduction with mean number i.e. 0.99 larvae but it was statistically superior in comparison to control in which 1.23 mean larvae were recorded. In this experiment we observed that the organic or botanical biopesticides proved best to manage the fruit borer population in tomato crop.

Keywords: Neem leaf, cow urine, *Helicoverpa armigera*, organic, moringa, biopesticides

Introduction
Vegetables play an important role in human day-to-day diet. Tomato *Lycopersicon esculentum* Mill. is one of the most popular and widely grown vegetable in the world. The highest productivity of tomato is incurred by Spain having 66.81 t/ha. In India, it is grown in 814 (000) million ha area with 20,515(000) million tones production and 25.20 t/ha productivity. In India, Andhra Pradesh contributed maximum production (2845.64 MT) and share 13.87% of total state production but highest productivity was occupied by Maharashtra (28.20 tons/ha). (Source: All India (First Estimates), Department of Agriculture, Cooperation and Farmers welfare report 2018.). In U.P., tomato grown in an area of about 21.2 million hectare and production is about 832.50 million tons (Source: State Departments of Horticulture & Agriculture annual report 2017-18). Mandloi *et al.*, (2015) [2] reported that the production and quality of tomato fruits are considerably affected by array of insect pests infesting at different stages of crop growth. The key insect pests of tomato include Aphid (*Aphis gossypii* Glover), Jassid (*Amrasca devastans* Ishida), White fly (*Bemisia tabaci* Genn.), Leaf miner (*Liriomyza trifolii* Burgess), Thrips (*Scirtothrips dorsolis* Hood) and Fruit borer (*Helicoverpa armigera* Hub.) etc. Fruit borer play an important role in the production of tomato crop because it affect directly to the economic part of plant i.e. fruits.

Materials and Methods
The field experiment entitled "To study the bio-efficacy of natural compounds against *Helicoverpa armigera* in tomato*"*. were conducted in Rabi season during 2018-2019 and 2019-2020 in the Student Instructional Farm (SIF) at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The field was prepared to fine tilth for transplanting of the seedlings. First weeds were removed manually to avoid their further growth in the field and then a deep ploughing was done by turning soil plough during second week of October in both the year 2018-19 and 2019-20. Later two deep ploughing was done by cultivator for providing good soil condition for plant growth in the field followed by planking.

The seedlings of tomato variety Azad T-5 were procured from Vegetable Research Station, Kalyanpur, Kanpur. The transplanting was done on 1 November 2018 and 5 November 2019, for both the year. For present experiment 20-25 old days seedlings of tomato variety Azad T-5 were transplanted in the field. the experiment was laid out in Completely Randomized Block Design (CRBD). Field experiment having nine treatments including one control and replicated thrice. The tomato seedlings were transplanted in 4.5 X_3 m^2 plots with 75×60 cm spacing and all the recommended agronomical practices were followed to raise the crop. Single seedling was transplanted at a single spot and a light irrigation was provided after planting of the seedlings. Only the healthy plants were allowed to grow and weaker and dead plants were replace by gap filling process after one week of transplanting.

Table 1: Recommended dose of botanical bio pesticide for tomato fruit borer as spray

S. No.	Name of insecticides	Dose/lit water	Concentration of bio pesticides
1.	Cow Urine	50 ml	0.5%
2.	Tobacco extract	50 ml	0.5%
3.	Moringa Leaf Extract	50 ml	0.5%
4.	Neem Leaf Extract	50 ml	0.5%
5.	Cow Urine + Tobacco Extract	50 ml	0.5%
6.	Cow Urine + Neem Leaf Extract	50 ml	0.5%
7.	Cow Urine + Moringa Leaf Extract	50 ml	0.5%
8.	Cow Dung Ash.	50 gm/plant	-
9.	Control.	_	_

Result and Discussion

Cow urine + *neem* leaf extract 5% @ 50 ml/l. with 38.01 population reduction over control proved best among all treatments by reducing mean number of larvae to the tune of 0.76 larvae. The second best treatment applied to the tomato crop was *neem* leaf extract 5% @ 50 ml/l, with 35.02 population reduction over control with mean number of larvae i.e. 0.80. Treatment cow dung ash as splitting form was found most inferior among all the treatments with 19.37 population reduction with mean number i.e. 0.99 larvae but it was statistically superior in comparison to control in which 1.23 mean larvae were recorded. Cow urine + *neem* leaf extract 5% @ 50 ml/l. with 38.35 population reduction proved best among all treatments by reducing mean number of larvae to the tune of 0.99 larvae, which was statistically at par with *neem* leaf extract 5% @ 50 ml/l, with 37.36 population reduction with mean number of larvae i.e. 1.01, Treatment cow urine 5% @ 50 ml/l was found most inferior among all the treatments with mean number i.e. 1.28 larvae with 20.87 population reduction over control but it was statistically superior in comparison to control in which 1.61 larvae were recorded. Cow urine + *neem* leaf extract 5% @ 50 ml/l. with 38.90 population reduction proved best among all treatments by reducing mean number of larvae to the tune of 1.14 larvae, which was statistically at par with *neem* leaf extract 5% @ 50 ml/l, with 36.38 population reduction with mean number of larvae i.e. 1.18, the second best treatment *neem* leaf extract was at par with cow urine + tobacco with mean number of larvae 1.27. Least effective treatment was cow dung ash as splitting and moringa leaf extract 5% @ 50 ml/l, with mean 1.43 and 1.40 respectively, cow dung ash was found most inferior among all the treatments with mean number i.e. 1.43 larvae but it was statistically superior in comparison to control in which 1.86 larvae were recorded. Solangi (2019) examine the efficacy of different.

Biopesticides against insect pests of tomato. Treatments were based on different biopesticides *neem* (*Azadirachta indica*), Dhatura (*Dhatura stramonium*), Tooh (*Citrullus colocynthus* Schrad) and Tobacco (*Nicotiana tabacum*). Cow urine + *neem* leaf extract 5% @ 50 ml/l. with 42.34 population reduction over control proved best among all treatments by reducing mean number of larvae to the tune of 0.77 larvae, which was statistically at par with *neem* leaf extract 5% @ 50 ml/l, with 37.78 population reduction with mean number of larvae i.e. 0.83, which was statistically at par with cow urine + tobacco 5% @ 50 ml/l, moringa leaf extract 5% @ 50 ml/l and tobacco extract with mean number of larvae 0.87, 0.92 and 0.93 respectively. Treatment cow dung ash was found most inferior among all the treatments with mean number i.e. 1.09 larvae but it was statistically superior in comparison to control in which 1.33 larvae were recorded. Cow urine + *neem* leaf extract 5% @ 50 ml/l. with 46.65 population reduction over control proved best among all treatments by reducing mean number of larvae to the tune of 0.81 larvae, which was statistically at par with *neem* leaf extract 5% @ 50 ml/l, with 43.96 population reduction with mean number of larvae i.e. 0.85. Treatment cow dung ash was found most inferior among all the treatments with mean number i.e. 1.37 larvae with 10.03 population reduction over control but it was statistically superior in comparison to control in which 1.52 larvae were recorded. Cow urine + *neem* leaf extract 5% @ 50 ml/l. as spray on standing crop with 23.95 population reduction over control proved best among all treatments by reducing mean number of larvae to the tune of 1.07. The second best treatment was *neem* leaf extract 5% @ 50 ml/l, with 17.64 population reduction over control with mean number of larvae i.e. 1.16, which was statistically at par with cow urine + tobacco extract 5% @ 50 ml/l and tobacco extract 5% @ 50 ml/l, with mean number of larvae 1.17 and 1.18 with 16.44 and 15.87 population reduction over control, respectively,. Treatment cow dung ash was found most inferior among all the treatments with mean number i.e. 1.33 larvae with 5.59 population reduction over control but it was statistically superior in comparison to control in which 1.41 larvae were recorded. Bajpai and Sehgal (2000) [4] conducted a field trial on seven botanical insecticides including *neem*, karanj (*Pongamia pinnata*) and tobacco formulations for control of pod borer. Lal and Verma (2006) [3] present study was carried out to identify the important Indigenous Technology Knowledge (ITKs) in use, methods for managing the insect-pests of the different crops and to document the same. Farmers commonly use ash against chewing and sucking type of insect pests. Use of cattle litter reduces the insect-pests of the crops significantly. Man and Surya (2010) [5] the effects of tobacco leaf extract, NSKE resulted in the greatest average plant height (62.54 cm), number of branches per plant

(12.43), fruit yield (36.98 t/ha) and net return (75 850 rupees/ha), and the lowest incidence of fruit borer infestation (5.84%) and fruit damage (7.37%). The highest cost:benefit ratios were obtained with *Neem* Leaf Extract,1:51.

Table 2: Effect of different natural compounds on infestation of *Helicoverpa armigera.*

S.N.	Treatments	Dose/ha.		Mean Larval population of *H. armigera*					PROC
				Before spray	After spray				
		a.i.(g)	Forml.(ml/lt.)	1Day	5Day	10Day	15Day	Mean	
1	T1 (Cow urine)	5%	50	0.66 (1.073)	0.13 (0.787)	0.46 (0.973)	0.66 (1.073)	0.40 (0.944)	23.80
2	T2 (Tobacco)	5%	50	0.66 (1.007)	0.23 (0.867)	0.40 (0.940)	0.53 (1.009)	0.40 (0.938)	24.29
3	T3 (Moringa leaf extract)	5%	50	0.60 (1.040)	0.20 (0.830)	0.40 (0.937)	0.53 (1.007)	0.40 (0.925)	25.34
4	T4 (Neem leaf extract)	5%	50	0.60 (1.040)	0.06 (0.743)	00 (0.700)	0.46 (0.973)	0.20 (0.805)	35.02
5	T5 (Cow urine + Tobacco)	5%	50	0.46 (0.970)	0.20 (0.830)	0.33 (0.900)	0.53 (1.003)	0.34 (0.911)	26.47
6	T6 (Cow urine + Neem leaf extract)	5%	50	0.73 (1.107)	00 (0.700)	00 (0.700)	0.33 (0.903)	0.10 (0.768)	38.01
7	T7 (Cow urine + Moringa leaf extract)	5%	50	0.40 (0.940)	0.20 (0.830)	0.26 (0.860)	0.66 (1.073)	0.34 (0.921)	25.66
8	T8 (Cow dung ash)	-	-	0.73 (1.107)	0.20 (0.830)	0.46 (0.973)	0.93 (1.193)	0.48 (0.999)	19.37
9	T9 (Control).	-	-	0.80 (1.133)	0.80 (1.133)	1.16 (1.293)	1.16 (1.297)	1.06 (1.239)	-
S.Em. ±				0.040	0.030	0.031	0.043	0.032	
CD at 5%				0.122	0.091	0.095	0.130	0.098	

Table 3: Effect of different natural compounds on infestation of *Helicoverpa armigera*

S.no.	Treatments	Dose		Mean Larval population of *H. armigera*					PROC
				Before spray	After spray				
		a.i. (g)	Forml. (ml/l)	1Day	5Day	10Day	15Day	Mean	
1	T1 (Cow urine)	5%	50	0.73 (1.100)	0.60 (1.040)	1.29 (1.340)	1.66 (1.463)	1.18 (1.281)	20.87
2	T2 (Tobacco)	5%	50	1.00 (1.213)	0.46 (0.973)	0.93 (1.193)	1.40 (1.370)	0.93 (1.179)	27.17
3	T3 (Moringa leaf extract	5%	50	1.13 (1.273)	0.53 (1.007)	1.06 (1.247)	1.29 (1.347)	1.01 (1.200)	25.88
4	T4 (Neem leaf extract)	5%	50	1.20 (1.300)	0.13 (0.787)	0.53 (1.007)	1.06 (1.247)	0.53 (1.014)	37.36
5	T5 (Cow urine + Tobacco)	5%	50	1.00 (1.220)	0.33 (0.903)	0.86 (1.167)	1.46 (1.393)	0.83 (1.154)	28.72
6	T6 (Cow urine + Neem leaf extract)	5%	50	1.40 (1.370)	00 (0.700)	0.46 (0.973)	1.26 (1.320)	0.53 (0.998)	38.35
7	T7 (Cow urine + Moringa leaf extract)	5%	50	1.26 (1.317)	0.53 (1.007)	0.80 (1.140)	1.40 (1.370)	0.86 (1.172)	27.60
8	T8 (Cow dung ash)	-	-	1.323	1.073	1.187	1.483	1.06 (1.248)	22.91
9	T9 (Control).	-	-	1.93 (1.553)	1.66 (1.463)	2.13 (1.620)	2.66 (1.773)	2.13 (1.619)	-
S.E.m. ±				0.048	0.035	0.039	0.046	0.029	
CD at 5%				0.146	0.105	0.118	0.140	0.087	

Table 4: Effect of different natural compounds on infestation of *Helicoverpa armigera.*

S. N.	Treatments	Dose/ha.		Population of *H. armigera*					PROC
				Before spray	After spray				
		a.i. (g)	Forml. (ml)	1Day	5Day	10Day	15Day	Mean	
1	T1 (Cow urine)	5%	50	2.06 (1.597)	0.86 (1.167)	1.60 (1.440)	1.60 (1.440)	1.29 (1.349)	27.70
2	T2 (Tobacco)	5%	50	1.73 (1.483)	1.00 (1.220)	1.20 (1.293)	1.60 (1.460)	1.22 (1.324)	29.04
3	T3 (Moringa leaf extract)	5%	50	1.93 (1.557)	1.00 (1.220)	1.26 (1.397)	2.06 (1.583)	1.58 (1.400)	24.97
4	T4 (Neem leaf extract)	5%	50	2.06 (1.597)	0.73 (1.100)	0.86 (1.167)	1.20 (1.293)	0.93 (1.187)	36.38
5	T5 (Cow urine + Tobacco)	5%	50	2.00 (1.570)	0.80 (1.140)	1.26 (1.323)	1.33 (1.370)	1.16 (1.278)	31.51

6	T6 (Cow urine + Neem leaf extract)	5%	50	2.00 (1.577)	0.60 (1.040)	0.86 (1.160)	1.00 (1.220)	0.80 (1.140)	38.90
7	T7 (Cow urine + Moringa leaf extract)	5%	50	2.06 (1.597)	0.80 (1.140)	1.20 (1.297)	1.80 (1.490)	1.20 (1.309)	29.84
8	T8 (Cow dung ash)	-	-	2.20 (1.640)	1.00 (1.220)	1.53 (1.417)	2.33 (1.677)	1.55 (1.438)	22.93
9	T9 (Control).	-	-	2.86 (1.827)	2.93 (1.850)	2.80 (1.810)	3.26 (1.937)	2.94 (1.866)	-
S.E.m. ±				0.028	0.044	0.038	0.032	0.039	
CD at 5%				0.084	0.132	0.116	0.096	0.118	

Table 5: Effect of different natural compounds on infestation of *Helicoverpa armigera*

S.N.	Treatments	Dose/ha.		Population of *H. armigera*					PROC
				Before spray	After spray				
		a.i. (g)	Forml.(ml)	1Day	5Day	10Day	15Day	Mean	
1	T1 (Cow urine)	5%	50	1.53 (1.410)	0.80 (1.140)	1.25 (1.330)	1.42 (1.387)	0.68 (1.080)	19.34
2	T2 (Tobacco)	5%	50	1.06 (1.343)	0.46 (0.973)	1.00 (1.213)	1.20 (1.297)	0.38 (0.939)	29.87
3	T3 (Moringa leaf extract)	5%	50	0.53 (1.007)	0.38 (0.933)	0.55 (1.023)	1.06 (1.240)	0.35 (0.920)	31.29
4	T4 (Neem leaf extract)	5%	50	0.46 (0.973)	0.21 (0.840)	0.33 (0.900)	0.66 (1.073)	0.20 (0.833)	37.78
5	T5 (Cow urine + Tobacco)	5%	50	1.12 (1.270)	0.38 (0.937)	0.60 (1.040)	0.78 (1.133)	0.25 (0.879)	34.35
6	T6 (Cow urine + Neem leaf extract)	5%	50	0.60 (1.040)	0.13 (0.787)	0.23 (0.867)	0.66 (1.073)	0.10 (0.772)	42.34
7	T7 (Cow urine + Moringa leaf extract)	5%	50	1.60 (1.440)	0.46 (0.973)	1.29 (1.320)	0.86 (1.160)	0.49 (0.996)	25.61
8	T8 (Cow dung ash)	-	-	2.34 (1.680)	0.60 (1.040)	1.75 (1.503)	0.93 (1.193)	0.69 (1.093)	18.37
9	T9 (Control).	-	-	2.60 (1.757)	1.06 (1.230)	1.91 (1.540)	1.42 (1.380)	1.29 (1.339)	-
S.E.m. ±				0.036	0.027	0.048	0.047	0.040	
CD at 5%				0.109	0.083	0.144	0.143	0.120	

Table 6: Effect of different natural compounds on infestation of *Helicoverpa armigera*

S.N.	Treatments	Dose/ha.		Population of *H. armigera*					PROC
				Before spray	After spray				
		a.i. (g)	Forml.(ml)	1Day	5Day	10Day	15Day	Mean	
1	T1 (Cow urine)	5%	50	1.43 (1.397)	0.40 (0.940)	1.06 (1.247)	1.38 (1.370)	1.12 (1.272)	16.53
2	T2 (Tobacco)	5%	50	1.53 (1.417)	0.46 (0.973)	0.80 (1.140)	0.93 (1.193)	0.95 (1.200)	21.25
3	T3 (Moringa leaf extract)	5%	50	1.64 (1.460)	0.74 (1.117)	1.36 (1.360)	1.60 (1.437)	1.20 (1.301)	14.63
4	T4 (Neem leaf extract)	5%	50	0.40 (0.940)	0.20 (0.830)	0.20 (0.830)	1.20 (1.297)	0.24 (0.854)	43.96
5	T5 (Cow urine + Tobacco)	5%	50	1.20 (1.300)	0.20 (0.830)	0.46 (0.973)	0.93 (1.193)	0.66 (1.004)	34.12
6	T6 (Cow urine + Neem leaf extract)	5%	50	0.38 (0.937)	0.12 (0.787)	0.20 (0.830)	0.66 (1.073)	0.17 (0.813)	46.65
7	T7 (Cow urine + Moringa leaf extract)	5%	50	0.46 (0.973)	0.31 (0.893)	0.49 (0.997)	1.00 (1.210)	0.53 (1.010)	33.72
8	T8 (Cow dung ash)	-	-	2.18 (1.637)	0.78 (1.133)	1.44 (1.390)	0.93 (1.193)	1.38 (1.371)	10.03
9	T9 (Control).	-	-	2.18 (1.633)	1.42 (1.380)	1.73 (1.493)	1.24 (1.317)	1.84 (1.524)	-
S.E.m. ±				0.042	0.047	0.057	0.040	0.038	
CD at 5%				0.128	0.141	0.171	0.120	0.116	

Table 7: Effect of different natural compounds on infestation of *Helicoverpa armigera*

S.N.	Treatments	Dose/ha.		Population of *H. armigera*					PROC
				Before spray	After spray				
		a.i.(g)	Forml.(ml)	1Day	5Day	10Day	15Day	Mean	
1	T1 (Cow urine)	5%	50	1.38 (1.370)	0.33 (0.903)	1.29 (1.323)	1.12 (1.273)	1.24 (1.313)	6.94
2	T2 (Tobacco)	5%	50	0.93	0.33	0.60	1.06	0.90	15.87

				(1.193)	(0.903)	(1.033)	(1.233)	(1.187)	
3	T3 (Moringa leaf extract)	5%	50	1.00 (1.220)	0.38 (0.933)	0.53 (1.010)	1.24 (1.317)	1.08 (1.259)	10.77
4	T4 (Neem leaf extract)	5%	50	1.60 (1.440)	0.60 (1.040)	0.80 (1.140)	0.78 (1.133)	0.86 (1.162)	17.64
5	T5 (Cow urine + Tobacco)	5%	50	0.95 (1.207)	0.20 (0.830)	0.23 (0.867)	0.86 (1.167)	0.88 (1.179)	16.44
6	T6 (Cow urine + Neem leaf extract)	5%	50	1.00 (1.217)	0.06 (0.743)	0.06 (0.743)	0.66 (1.073)	0.66 (1.073)	23.95
7	T7 (Cow urine + Moringa leaf extract)	5%	50	2.14 (1.620)	0.73 (1.107)	1.05 (1.220)	1.30 (1.343)	1.08 (1.244)	11.83
8	T8 (Cow dung ash)	-	-	2.18 (1.640)	1.06 (1.340)	1.60 (1.443)	1.36 (1.367)	1.29 (1.332)	5.59
9	T9 (Control).	-	-	1.06 (1.340)	0.67 (1.083)	1.24 (1.313)	1.53 (1.410)	1.53 (1.411)	-
S.E.m. ±				0.034	0.037	0.043	0.055	0.022	
CD at 5%				0.102	0.111	0.129	0.165	0.068	

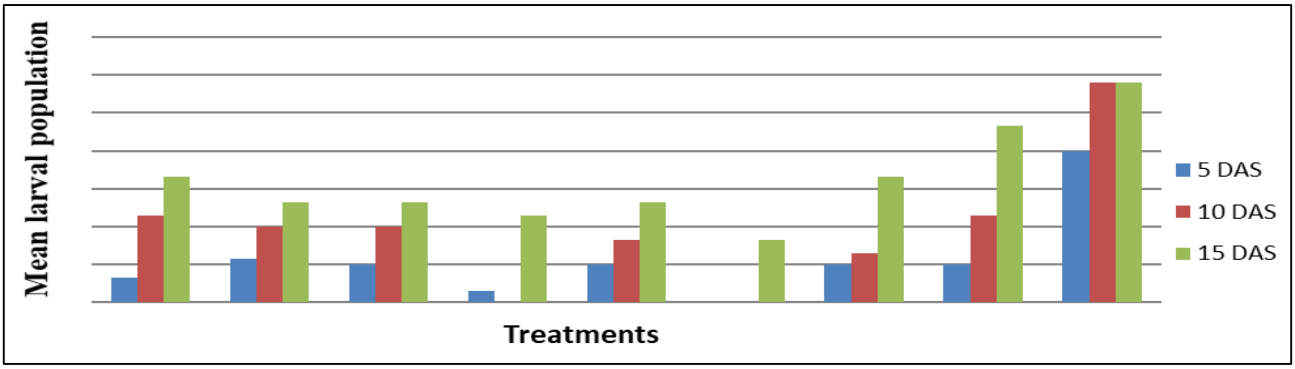

Fig 1: Effect of different natural compounds on infestation of Helicoverpa armigera.2018-19

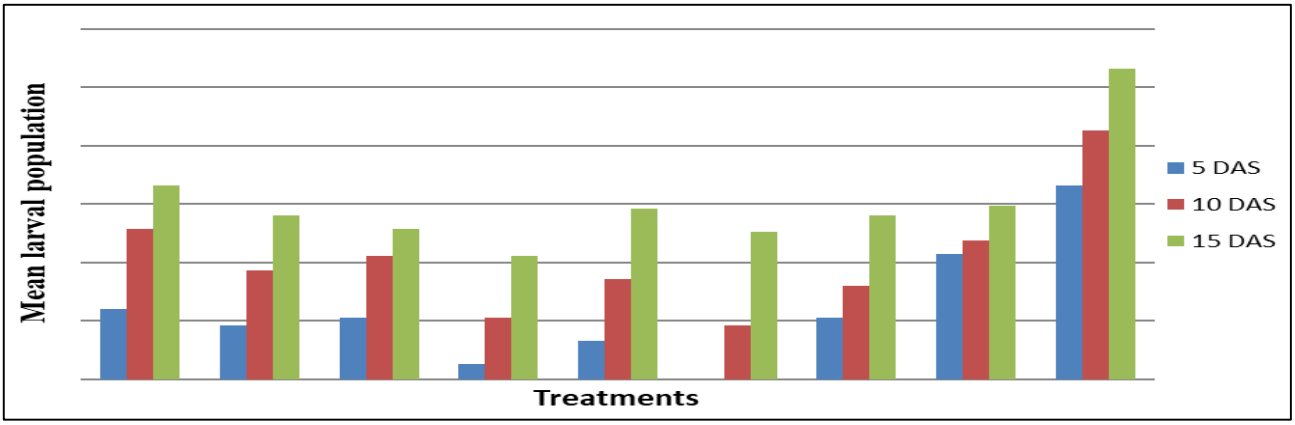

Fig 2: Effect of different natural compounds on infestation of *Helicoverpa armigera.2018-19*

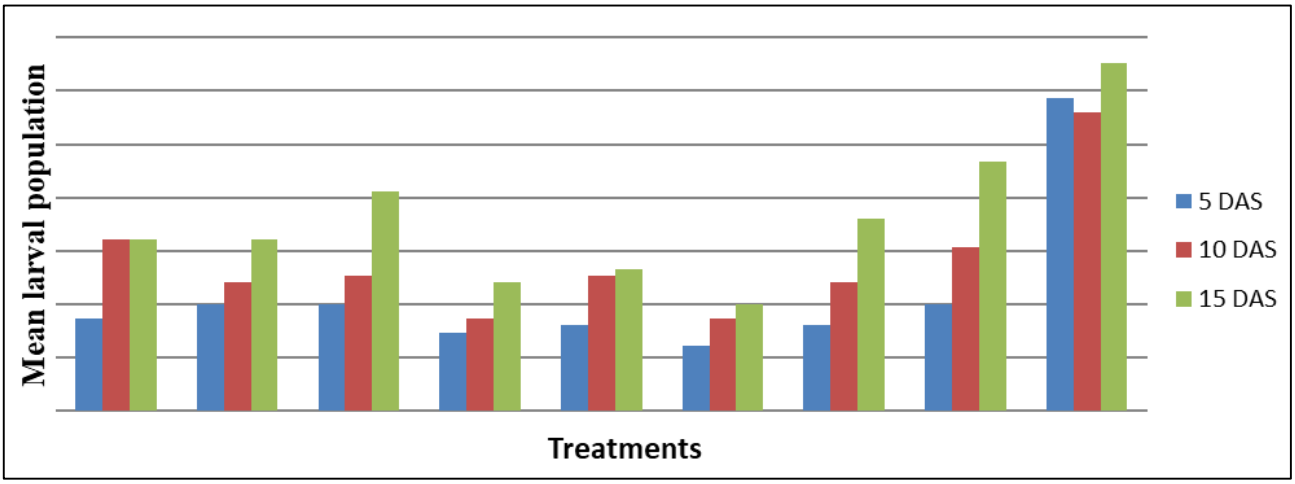

Fig 3: Effect of different natural compounds on infestation of Helicoverpa armigera.2018-19

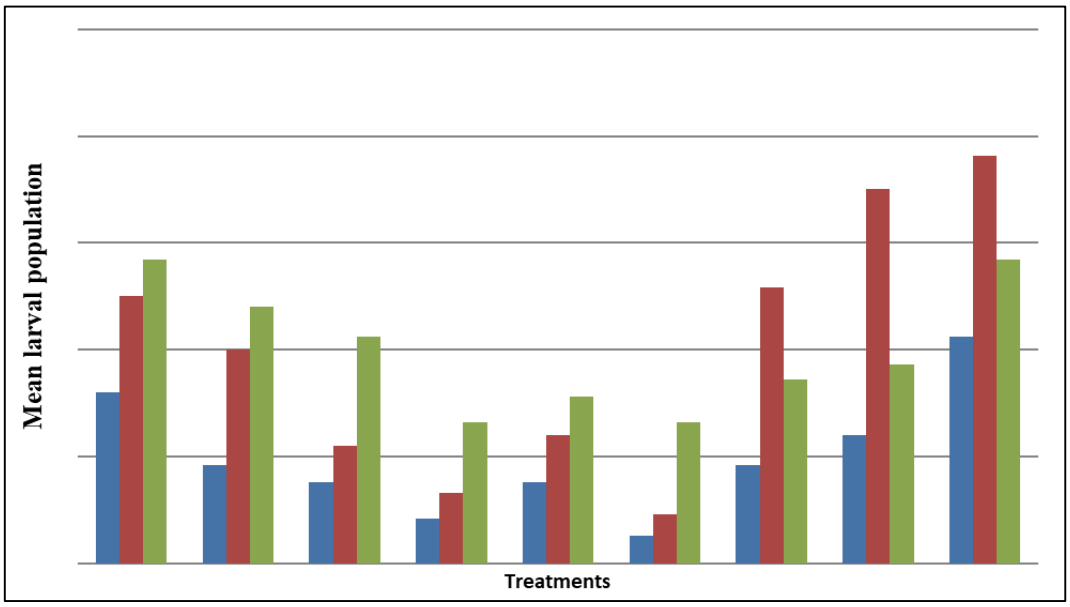

Fig 4: Effect of different natural compounds on infestation of Helicoverpa armigera.2019-20

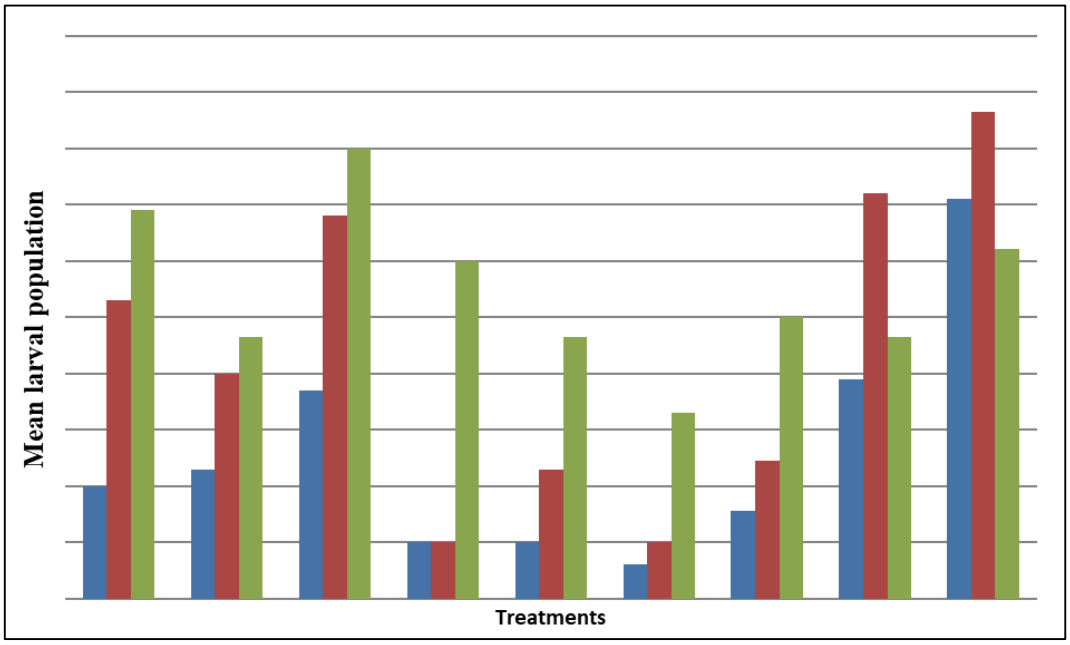

Fig 5: Effect of different natural compounds on infestation of Helicoverpa armigera.2019-20

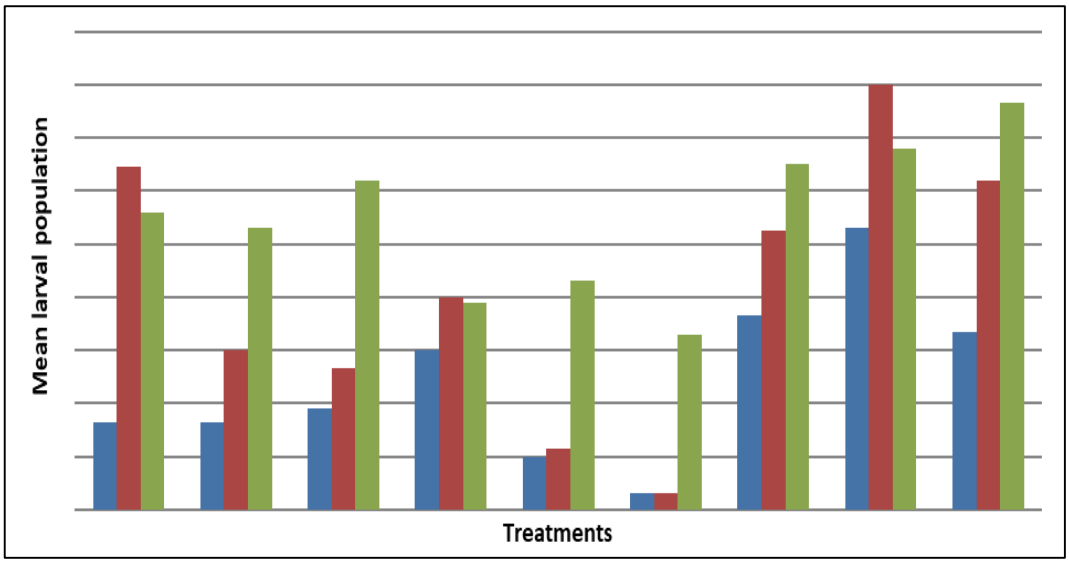

Fig 6: Effect of different natural compounds on infestation of *Helicoverpa armigera.2019-20*

Conclusion

Efficacy of natural products revealed that the Cow urine + *Neem* leaf extract 5% @ 50 ml/l was proved best to check the *Helicoverpa armigera* population organically in both the years. Treatments effect on reducing larval population are indicating in descending order i.e. T6 (Cow urine + *Neem* leaf extract) > T4 (*Neem* leaf extract) > T5 (Cow urine + Tobacco) > T7 (Cow urine + Moringa leaf extract) > T3 (Moringa leaf extract) > T2 (Tobacco) > T1 (Cow urine) > T8 (Cow dung ash) and untreated control. In this present study we concluded that the natural compounds are very useful in reducing pest population and cheapest source of insecticides to the farmers, no harmful effects on human as well as animal body. So we can easily employed in organic farming to get high quality chemical free products and export to foreign countries to get hard money. These all treatments are beneficial in reducing various diseases which caused by chemical insecticides. In future, scope of organic products will increase due to the bed effects of chemical insecticides on the human health which is harmful to our nature. So the management of insects population in organic farming can be manages by using organic insecticides which will be harmless to the animals and our ecosystem.

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