The Pharma Innovation Journal 2023; 12(3): 2723-2728

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 2723-2728

www.thepharmajournal.com
Received: 08-01-2023
Accepted: 12-02-2023

Mayanglambam Somorjit Singh
Ph.D. Scholar, Department of Entomology, School of Agricultural Sciences & Rural Development (NU: SASRD), Medziphema, Nagaland, India

Konjengbam Mamocha Singh
Professor, Department of Entomology, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Karthik R
Ph.D. Scholar,
Department of Entomology, College of Agriculture, Assam Agricultural University, Jorhat, Assam, India

Rameshwar
Ph.D. Scholar, School of Agricultural Sciences & Rural Development (NU: SASRD), Medziphema, Nagaland, India

Corresponding Author:
Mayanglambam Somorjit Singh
Ph.D. Scholar, Department of Entomology, School of Agricultural Sciences & Rural Development (NU: SASRD), Medziphema, Nagaland, India

Eco-friendly management of major pests of king chilli (*Capsicum chinense* Jacquin) under Manipur Valley condition

Mayanglambam Somorjit Singh, Konjengbam Mamocha Singh, Karthik R and Rameshwar

Abstract
A field experiment was conducted during *kharif* 2018 at College of Agriculture, Central Agricultural University, Imphal to evaluate the effect of different eco-friendly management practices including two insecticides for management of the major pests of King chilli. The results revealed that the minimum population of aphids 0.41/leaf was recorded on Imidacloprid and the maximum population of aphids 2.75/leaf was recorded on control whereas the minimum (0.26/leaf) and maximum (1.17/leaf) population of thrips were recorded on the treatment of spinosad and control respectively. The lowest and highest per cent fruit damage by fruit fly were recorded on the treatment of Cow urine+ neem pesticide (7.30%/plant) and control (25.50%/plant) respectively. However, the maximum and minimum yield of king chilli were recorded on the treatment of cow urine+neem pesticide (3243.30 kg/ha) and control (1677.78 kg/ha) respectively.

Keywords: Major-pests, eco-friendly, management, insecticides, yield

1. Introduction
Among spices, King Chilli (*Capsicum chinense* Jacquin) is an essential crop, producing in north-east India. The fruit is known for its pungency as well as taste. King chilli belongs to the family *Solanaceae,* is traditionally cultivated in Manipur, Nagaland, Assam and other north eastern states of India. The chilli has been called by different local names. In Manipur, King chilli is most popularly known as 'U-morok' (which means 'tree chilli'),'Bhut jolokia' or 'Ghost chilli' in Assam and 'Raja Mircha' in Nagaland (Gogoi, 2017) [3]. In Manipur, king chilli is more extensively grown and produced in the hilly districts than the valley areas. Several challenges are faced by the king chilli growers regarding soil, climate, pests and diseases, etc. (Biswas *et al*., 2017) [2]. Among these constraints, pests and diseases play a major role in king chilli production (Thangjam *et al*., 2017) [18]. Among the pests, aphids (*Aphis gossypii*), thrips (*Scirtothrips dorsalis*) and fruit flies *(Bactrocera latifrons*) were identified as the major ones. In order to avoid the economic loss of king chilli, the management of these pests were necessary. Hence various management practices including eco-friendly methods and insecticidal treatments were evaluated in the present study.

2. Materials and Methods
The field experiment was conducted at College of Agriculture, Central Agricultural University, Imphal, during *kharif*, 2018 to manage the major pests of king chilli with 10(ten) different treatments including control. The local cultivar of king chilli seeds @ 1kg/ha were sown in trays filled with fine soil mixed with compost. Proper watering was done at regular intervals till the seedlings attain transplanting stage. The main field was ploughed two times for fine tilth. Beds were made to a size of 3m x 2m. The recommended dose of NPK was applied at the rate of 80: 40: 40 g per plot. This was achieved through application of urea, SSP and MOP @ 171.2 g, 250 g and 68 g respectively. Thirty days old seedlings were transplanted from the trays to the main field with a spacing of 60cm x 60cm. Irrigation was provided at the time of transplantation and throughout the cropping period as and when needed. Timely weeding's were also carried out regularly to reduce the crop weed competition.

2.1 Design and treatment of the experiment

In this experiment, Randomized Block Design (RBD) with 10 treatments and 3 replications were evaluated. The details of the different treatments evaluated for their efficacy against the major pests of king chilli are listed in Table 1. Two necessary sprayings of the treatments were made at 30 and 60 days after transplanting (DAT). In case of treatment six and seven, which were the mulching of plots with black and white polythene, respectively, mulching were done before transplanting. Circular holes were made at proper plant spacing for transplanting the seedlings.

Table 1: Treatment details of the experiment

Treatment	Components	Method of preparation & dosage
T_1	Neem formulation	4 ml of Neemazal 1% EC was added in 1 litre of water.
T_2	*Melia azedarach* L. Crude extract	1 kg of fresh leaves was crushed and soaked in 2.5 litres of water overnight. The extract was strained using muslin cloth and mixed with water @10 litres/20 litres of water. In the spray solution, surf excel was added @1g/litre of spray solution.
T_3	Cow urine+neem pesticide	1 kg of *Melia azedarach* + 4 litres of cow urine was kept in an earthen pot for 21 days. The filtrate was boiled to reduce the volume to one-fourth. The solution was applied to the crop @ 100 ml/10 litres of water. Surf excel was added as in T_2 (Kanojia *et al*., 2005) [5].
T_4	Cow urine 5%	5 ml of cow urine was added to 95 ml of water. Surf excel was added as in T_2.
T_5	Cow urine 10%	10 ml of cow urine was added to 90 ml of water. Surf excel was added as in T_2.
T_6	Mulching	Black polyethylene
T_7	Mulching	White polyethylene
T_8	Spinosad 45% SC	@ 0.32ml/lit of water
T_9	Imidacloprid 17.8% SL	@0.3ml/1lit of water
T_{10}	Control	Water spray

2.2 Observations recorded

2.2.1 Sucking pests (aphids and thrips)

For sucking pests, observations were recorded at 1 day before spraying (DBS) and 1 day, 3 days, 7 days and 14 days after spraying (DAS). During each observation, the population of sucking pests like aphids and thrips were counted from 6 leaves (i.e., 2 leaves each from top, middle and lower portion of the plant) from the randomly selected five plants in a plot and mean number of insects per leaf was recorded.

2.2.2 Fruit fly

The effect of different treatments on fruit fly infestation was recorded at 70, 80, 90 and 100 days after transplanting (DAT). The infestation by fruit fly was recorded by counting the total number of healthy and damaged fruits in the 10 numbers of randomly selected plants of each replication. Per cent fruit fly infestation was calculated as follows:

$$\text{Per cent fruit damaged} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits}} \times 100$$

2.2.3 Yield

The total yield (kg/ha) of king chilli was recorded from four different pickings and the mean yield was compared among the different treatments.

3. Results and Discussion

3.1 Aphids

The data on mean aphid (*Aphis gossypii)* population from 1st round spray (30 DAT), 2nd round spray (60 DAT) at 1 DBS, 1 DAS, 3 DAS, 7 DAS and 14 DAS are depicted in Table 2. The results of mean reduction of aphid population from 1st and 2nd spray are being described below. The mean aphid (*Aphis gossypii*) population at 1 DBS showed no significant difference among the treatments and the mean aphid (*Aphis* gossypi) population ranged from 2.49/leaf to 2.87/leaf. The mean reduction of aphid (*Aphis* gossypii) population from 1, 3, 7 and 14 DAS showed significant difference among the treatments. The minimum population of aphids, 0.86 (1.22)/ leaf was found on imidacloprid while maximum population of aphids, 2.80 (1.81) / leaf was recorded on control at 1 DAS. Similar results obtained from 3 DAS which showed that minimum population of aphids, 0.23 (0.85)/ leaf was found on imidacloprid while maximum population of aphids, 2.76 (1.80) / leaf was recorded on control. Likewise, at 7 DAS also minimum population of aphids, 0.05 (0.74)/ leaf was found on imidacloprid while maximum population of aphids, 2.63 (1.77) / leaf was recorded on control. At 14 DAS, minimum population of aphids, 0.38 (0.94)/ leaf was found on imidacloprid while maximum population of aphids, 2.70 (1.79) / leaf was recorded on control. The mean reduction of aphid population from 1 DBS to 1 DAS, 3 DAS, 7 DAS and 14 DAS indicated that the minimum population of aphids was recorded on the treatment of imidacloprid 0.41 (0.94)/ leaf followed by Neemazal, 0.76 (1.11)/ leaf, spinosad, 0.85 (1.15)/leaf, cow urine 10%, 1.07 (1.24/leaf) and cow urine+ neem pesticide 1.20 (1.29)/ leaf. The aphid population on spinosad was at par with neem oil and aphid population on cow urine+ neem pesticide was at par with cow urine 10%. The maximum population of aphids was recorded on control, 2.75 (1.80)/leaf followed by black polythene mulching, 2.04 (1.59)/leaf, white polythene mulching, 1.83 (1.52)/leaf, cow urine 5%, 1.45 (1.39)/leaf and neem extract, 1.32 (1.34)/ leaf. The aphid population on black polythene mulching was at par with white polythene mulching and aphid population on neem extract was at par with cow urine 5% and cow urine+neem pesticide.

Rana *et al.* (2016) [12] also found the similar findings of aphids on chilli was effectively managed by imidacloprid 350 SC @ 150 ml/ha. Tukaram *et al.* (2017) [19] also reported that Imidacloprid 200 SL @ 250 ml/ha was effective against aphids in chilli. Neem oil also found to be effective against aphids of king chilli in present study which is in conformity with the results of Ahirwar *et al.* (2010) [1] who studied the efficacy of different indigenous products against sucking pests of sesame. The efficacy was in the order of Neem seed kernel extract (NSKE) > Neem oil > Neem leaf extract> Garlic+ Red pepper extract> Cow urine> Cow butter milk. Similarly, Shafie and Abdelraheem (2012) [16] found that

neemazal- T/S (2L/ha), xenTari (1kg/ha), spinosad (2lit/ha) were effective against tomato aphids, whitefly and fruit borer. Mustard aphid population reduction was found on the treatment of dimethoate followed by neem seed kernel extract (Meena *et al*. 2013) [8] which collaborates with the present findings. Spinosad also observed as better treatment for suppression of aphid population in king chilli which confirms to the findings of Pathipathi *et al*. (2017) who studied that bio efficacy of certain insecticides against aphids on capsicum. The maximum percent reduction of aphid population was found to be 40% which was achieved by spinosad @125 ml per ha. The comparative better performance by cow urine-neem pesticide for suppression of aphids confirms to the findings of Gupta (2005) who reported that 3- 4 spray of NSKE (in cow urine) 3% was effective against mustard aphid, *Lipaphis erysimi*. The comparative better performance by cow urine 10% and cow urine 5% for suppression of aphids are in partial agreement with the findings of Tesfaye and Gautam (2003) [17] who reported that urine from cattle is used to control aphid population in wheat cropping system. The minimum population of aphids (*Aphis gossypii*) was recorded on imidacloprid than other treatments in present study. Hence it can be concluded that imidacloprid was found to be the most effective one among the different treatments for management of aphids (*Aphis gossypii*) in King Chilli.

Table 2: Mean effect of two sprays of different treatments on Aphid (*Aphis gossypi*) population on King Chilli.

Treatment	No. of aphid/ leaf at 1 DBS	No. of aphid/ leaf at 1 DAS	No. of aphid/ leaf at 3 DAS	No. of aphid/ leaf at 7 DAS	No. of aphid/ leaf at 14 DAS	Mean
Neemazal @4ml/lit of water	2.59	1.42 (1.38)	0.78(1.13)	0.31 (0.90)	0.53 (1.01)	0.76 (1.11)
Neem extract	2.79	2.06 (1.60)	1.28(1.33)	0.81(1.15)	1.11(1.27)	1.32(1.34)
Cow urine+neem	2.75	1.93 (1.56)	1.21 (1.31)	0.62 (1.06)	1.03 (1.24)	1.20(1.29)
Cow urine 5%	2.81	2.18 (1.64)	1.41(1.38)	0.94 (1.20)	1.29 (1.34)	1.45 (1.39)
Cow urine 10%	2.49	1.72 (1.49)	1.09 (1.26)	0.60(1.05)	0.87 (1.17)	1.07(1.24)
Black polyethylene mulching	2.68	2.43 (1.71)	2.01 (1.59)	1.92 (1.56)	1.79 (1.51)	2.04 (1.59)
White polyethylene mulching	2.50	2.25(1.66)	1.81(1.52)	1.53 (1.42)	1.73(1.49)	1.83 (1.52)
Spinosad 45% SC	2.73	1.55 (1.43)	0.86 (1.17)	0.36(0.93)	0.63 (1.06)	0.85 (1.15)
Imidacloprid17.8%SL	2.69	0.86 (1.22)	0.23 (0.85)	0.05 (0.74)	0.38 (0.94)	0.41 (0.94)
Control	2.87	2.80 (1.81)	2.76(1.80)	2.63(1.77)	2.70(1.79)	2.75(1.80)
S.Ed (±)	NS	0.08	0.09	0.08	0.08	0.05
C.D	NS	0.17	0.18	0.17	0.17	0.10

NS- Non Significant
Figures in parentheses are square root transformed values
DBS- Day Before Spray
DAS- Days After Spray

3.2 Thrips

The data on mean thrips (*Scirtothrips dorsalis*) population from 1st round spray (30 days after transplanting), 2nd round spray (60 days after transplanting) at 1 DBS, 1 DAS, 3 DAS, 7 DAS and 14 DAS are depicted in Table 3. The results of mean reduction of thrips population from 1st and 2nd spray are being described below. The mean thrips (*Scirtothrips dorsalis*) population at 1 DBS showed no significant difference among the treatments and the mean thrips (*Scirtothrips dorsalis*) population ranged from 1.03/leaf to 1.28/leaf. The mean reduction of thrips population from 1, 3, 7 and 14 DAS showed significant difference among the treatments. The minimum population of thrips, 0.53 (1.02)/leaf was found on spinosad while maximum population of thrips, 1.25(1.32)/leaf was recorded on control at DAS. Similar results obtained from 3 DAS which showed that minimum population of thrips, 0.25 (0.87)/leaf was found on spinosad while maximum population of 1.10(1.26)/leaf was recorded on control. Likewise, at 7 DAS also minimum population of thrips, 0.05 (0.74)/ leaf was found on spinosad while maximum population of thrips, 1.16 (1.29)/ leaf was recorded on control. At 14 DAS, minimum population of thrips, 0.19 (0.83) / leaf was found on spinosad while maximum population of thrips, 1.16 (1.29)/ leaf was recorded on control. The mean reduction of thrips population from 1 DBS, 1 DAS, 3 DAS, 7 DAS and 14 DAS indicated that the minimum population of thrips was recorded on the treatment of spinosad, 0.26 (0.86)/ leaf followed by cow urine+neem pesticide, 0.45 (0.97)/ leaf, imidacloprid, 0.50 (0.99)/ leaf, neemazal, 0.60 (1.04)/ leaf and cow urine 10%, 0.68(1.08)/ leaf, cow urine 5%, 0.78(1.13)/leaf and neem extract, 0.84(1.15)/leaf in decending order. In the present investigation, the efficacy of Cow urine +neem pesticide was at par with Imidacloprid. The maximum population of thrips was recorded on control, 1.17 (1.29)/ leaf followed by white polythene mulching, 1.01 (1.23)/ leaf, black polythene mulching, 0.98(1.22)/ leaf, neem extract, 0.84 (1.15) / leaf and cow urine 5%, 0.78 (1.13)/ leaf.

The present findings for the management of chilli thrips are in partial agreement with the findings of Samota *et al*., (2017) who found that 77.90%, 61.65% and 48.95% reduction of thrips, *Scirtothrips dorsalis* population on chilli was achieved by Imidacloprid, Spinosad and Neem seed kernal extract (NSKE) respectively. The effective performance by Imidacloprid for suppression of thrips population are in partial agreement with the findings of Tukaram *et al*., (2017) [19] who reported that Imidacloprid 200 SL @ 250 mL/ha was effective against thrips in chilli. Khanzada *et al*., (2018) [6] also found that the lowest population of thrips (0.72) in chilli was observed in the treatment of Imidacloprid 17.8 SL @ 0.090 l/ha which is also in partial agreement with the present findings. Efficacy of neem formulations against thrips in chilli were also reported by Ahirwar *et al*., (2010) [1] and Pandey *et al.*, (2010) [10]. The minimum population of thrips was recorded on spinosad than other treatments in present study. Hence it can be concluded that spinosad was found to be the most effective one among the different treatments for management of thrips (*Scirtothrips dorsalis*) in King Chilli.

Table 3: Mean Effect of two rounds of sprays of different biopesticides on Thrips (*Scirtothrips dorsalis* Hood) infestation

Treatment	No. of thrips/ leaf at 1 DBS	No. of thrips/ leaf at 1 DAS	No. of thrips/ leaf at 3 DAS	No. of thrips/ leaf at 7 DAS	No. of thrips/ leaf at 14 DAS	Mean
Neemazal @ 4ml/lit of water	1.14	1.02 (1.23)	0.58 (1.04)	0.39 (0.94)	0.44(0.97)	0.60 (1.04)
Neem extract	1.16	1.15(1.29)	0.81(1.15)	0.69 (1.09)	0.69(1.09)	0.84 (1.15)
Cow urine+neem	1.03	0.90(1.18)	0.37(0.93)	0.21(0.84)	0.33(0.91)	0.45 (0.97)
Cow urine 5%	1.11	1.09(1.26)	0.72(1.11)	0.58(1.04)	0.71 (1.10)	0.78 (1.13)
Cow urine 10%	1.28	1.06(1.25)	0.66 (1.07)	0.44(0.97)	0.57(1.04)	0.68(1.08)
Black polyethylene mulching	1.14	1.15(1.28)	0.90(1.18)	0.89(1.18)	0.99 (1.22)	0.98(1.22)
White polyethylene mulching	1.20	1.11(1.27)	0.92(1.19)	0.94(1.20)	1.06 (1.25)	1.01 (1.23)
Spinosad 45% SC	1.07	0.53(1.02)	0.25 (0.87)	0.05(0.74)	0.19 (0.83)	0.26 (0.86)
Imidacloprid17.8%SL	1.07	0.96(1.21)	0.41(0.96)	0.24(0.86)	0.38(0.94)	0.50 (0.99)
Control	1.17	1.25(1.32)	1.10 (1.26)	1.16(1.29)	1.16 (1.29)	1.17 (1.29)
S.Ed (±)	NS	0.06	0.05	0.07	0.05	0.04
C.D	NS	0.12	0.10	0.14	0.10	0.08

NS- Non Significant
Figures in parentheses are square root transformed values
DBS- Day Before Spray
DAS- Days After Spray

3.3 Fruit borer

The effect of different biopesticides on fruit fly infestation i.e. per cent fruit damage by fruit fly at 70 DAT, 80 DAT, 90 DAT and 100 DAT and their mean are presented in Table 4. At 70 DAT, the per cent fruit damage ranged from 18.30 to 24.10% fruit damage/plant and significant difference was found among the treatments wherein the minimum per cent fruit damage (17.60% fruit damage/plant) was found on Cow urine+ neem pesticide and the maximum per cent fruit damage was recorded on Black polythene mulching (23.30% fruit damage/plant). The per cent fruit damage gradually reduces from 70 DAT to 100 DAT for all the treatments except for Black polythene mulching, White polythene mulching and Control. Also, all the treatments were recorded to be effective than Control. At 80 DAT, the minimum per cent fruit damage (7.70% fruit damage/plant) was found on Cow urine+ neem pesticide while maximum per cent fruit damage (23.40% fruit damage/plant) was recorded on black polythene mulching. Likewise, at 90 DAT also, the lowest per cent fruit damage (2.50% fruit damage/plant) was observed on Cow urine+ neem pesticide while highest per cent fruit damage (23.90% fruit damage/plant) was observed on Black polythene mulching. Comparatively lesser per cent fruit damage was found on 100 DAT than 70 DAT, 80 DAT and 90 DAT. At 100 DAT also, the minimum per cent fruit damage (1.30% fruit damage/plant) was found on Cow urine+ neem pesticide while maximum per cent fruit damage (21.50% fruit damage/plant) was found on White polythene mulching. The overall mean per cent fruit damage indicated that the lowest per cent fruit damage was recorded on the treatment of Cow urine+ neem pesticide (7.30% fruit damage/plant) which was followed closely by Neemazal (8.80%/plant), Spinosad (9.90%/plant) and Imidacloprid (10.60%/plant). The next effective treatments were found to be Cow urine 5% (11.10%/plant), Cow urine 10% (11.80%/ plant) and Neem extract (14.20%/plant). The highest per cent fruit damage was recorded on control (25.50%/plant) which was at par with Black polythene mulching (23.00%/ plant) and White polythene mulching (21.90%/ plant).

Sapkota *et al*., (2010) [15] also reported that biopesticides prepared by mixing plant parts and animal byproducts like cow urine and cow dung was effective against fruitflies. Mahmoud (2007) [7] also reported that azadirachtin especially neem seed kernal extract and Neemazal 5% in combination with *Steinernema feltiae* may increase the efficacy to control fruitfly, *Bactrocera zonata.*

Table 4: Effect of different biopesticides on fruit fly (*Bactrocera latifrons* Hendel) infestation

Treatment	Per cent fruit damage at 70 DAT	Per cent fruit damage at 80 DAT	Per cent fruit damage at 90 DAT	Per cent fruit damage at 100 DAT	Mean
Neemazal @ 4ml/lit of water	18.30 (4.28)	9.40 (3.06)	4.40 (2.10)	3.10 (1.75)	8.80 (2.96)
Neem extract	20.70 (4.54)	15.40 (3.92)	12.30 (3.51)	8.60 (2.93)	14.20 (3.76)
Cow urine+neem	17.60 (4.19)	7.70 (2.78)	2.50 (1.57)	1.30 (1.14)	7.30 (2.70)
Cow urine 5%	19.70 (4.44)	12.50 (3.53)	8.00 (2.83)	4.30 (2.06)	11.10 (3.34)
Cow urine 10%	20.10 (4.48)	12.50 (3.54)	9.30 (3.05)	5.10 (2.25)	11.80 (3.43)
Black polyethylene mulching	23.30 (4.83)	23.40 (4.83)	23.90 (4.89)	21.40 (4.62)	23.00 (4.80)
White polyethylene mulching	23.00 (4.80)	21.00 (4.58)	22.10 (4.70)	21.50 (4.63)	21.90 (4.68)
Spinosad 45% SC	19.30 (4.39)	11.00(3.30)	6.10 (2.46)	3.40 (1.80)	9.90 (3.14)
Imidacloprid 17.8%SL	19.70 (4.43)	11.70 (3.42)	7.40 (2.72)	3.60 (1.89)	10.60 (3.25)
Control	24.10 (4.91)	24.70 (4.97)	25.50 (5.05)	27.60 (5.25)	25.50 (5.05)
S.Ed (±)	0.10	0.14	0.15	0.17	0.38
C.D	0.21	0.31	0.31	0.35	0.79

Figures in parentheses are square root transformed values
DAT- Days after Transplanting

3.4 Yield

The effect of different treatments on healthy fruit yield (Kg/ha) of king chilli from first, second, third and fourth pickings are depicted in Table 5. The yield of king chilli showed significant difference among the treatments in all the pickings. At 1st picking, the yield of king chilli ranged from

411.17 kg/ha to 794.44 kg/ha. The significantly highest yield (794.44 Kg/ha) was found on Cow urine+ neem pesticide which was followed closely by Imidacloprid (750.08 Kg/ha) and Spinosad (705.51 Kg/ha). Untreated control showed lowest yield of 411.17 kg/ha. At 2nd picking, the king chilli yield recorded was in the similar trend with1st picking but comparatively higher. Cow urine+ neem pesticide treated plot recorded highest yield (838.80 kg/ha) while significantly lowest yield was recorded in control (444.42 kg/ha). Higher yield of king chilli was recorded at 3rd picking when compared with the previous two pickings. The highest and lowest yield was found on Cow urine+neem pesticide (861.12 kg/ha) and control (433.33 kg/ha) respectively. Comparatively lower yield was recorded at 4th picking than all the other pickings where the maximum and minimum yield were found on the treatment of Cow urine+neem pesticide (749.46 kg/ha) and control (388.85 kg/ha) respectively.

The total yield from these four pickings indicated that the maximum yield was recorded on the treatment of Cow urine+neem pesticide (3243.30 kg/ha) and it was closely followed by Imidacloprid (3066.67 kg/ha) and Spinosad (2988.89 kg/ha). The minimum yield was recorded on Control (1677.78 kg/ha) which was followed closely by Black polythene mulching (1850.00 kg/ha) and White polythene mulching (2038.89 kg/ha). Higher yield harvested in chilli with the treatment of Spinosad was also reported by Roopa and Kumar (2014) [13].

Table 5: Healthy fruit yield (Kg/ha) of king chilli from different treatments

Treatment	Yield (Kg/ ha) from 1st picking (70 DAT)	Yield (Kg/ ha) from 2nd picking (80 DAT)	Yield (Kg/ ha) from 3rd picking (90 DAT)	Yield (Kg/ ha) from 4th picking (100 DAT)	Total yield (Kg/ ha)
Neemazal @ 4ml/lit of water	672.24	683.35	711.12	622.21	2688.89
Neem extract	522.21	588.84	600.04	533.34	2244.44
Cow urine+neem pesticide	794.44	838.80	861.12	749.46	3243.89
Cow urine 5%	577.72	600.05	627.71	550.00	2355.56
Cow urine 10%	594.40	638.81	666.64	583.39	2483.33
Black polyethylene mulching	444.46	454.00	516.62	440.47	1850.00
White polyethylene mulching	494.42	500.03	577.71	466.62	2038.89
Spinosad 45% SC	705.51	738.87	822.26	722.25	2988.89
Imidacloprid 17.8% SL	750.08	755.56	822.28	738.87	3066.67
Control	411.17	444.42	433.33	388.85	1677.78
S.Ed (±)	29.840	29.47	45.64	36.39	79.17
C.D	62.68	61.90	95.85	76.42	166.27

DAT- Days After Transplanting

4. Conclusion

The management of pests on king chilli was done with 10 treatments including mulching treatment and control. It can be concluded that Imidacloprid was found to be effective treatment for aphids, while Spinosad was effective against thrips. Cow urine+neem pesticide was effective against fruit fly and the maximum yield was also recorded on Cow urine+neem pesticide. Perhaps it can be concluded that Cow urine+neem pesticide shall be the best treatment for management of pests in king chilli as it is also effective against sucking pest, otherwise Integrated Pest Management contains either Cow urine+neem pesticide or Imidacloprid or Spinosad shall give a solution for management of arthropod pests in king chilli. However, there is an investigation to be done based on pest complex and its natural enemies of king chilli in relation with climatic factors to make an effective Integrated Pest Management on King Chilli.

5. References

1. Ahirwar RM, Gupta MP, Banerjee S. Field efficacy of natural and indigenous products on sucking pests of Sesame. Indian Journal Natural Products and Resources. 2010;1(2):221-226.
2. Biswas PK, Menla K, Das R. Constraints faced by the Naga King chilli growers in Makokchung district of Nagaland. Agriculture Update. 2017;12(4):578- 580.
3. Gogoi B. *Capsicum chinense* Jacq. (Bhut Jolokia) – Rich source of capsaicin with wide application and economic potential. Annals of Plant Sciences. 2017;6(8):1664-1667.
4. Gupta MP. Efficacy of neem in combination with cow urine against mustard aphid and its effect on coccinellid predators. Natural Product Radiance. 2005;4(2):102-106.
5. Kanojia AK, Singh RV, Bambawale OM, Trivedi TP. Explored Indigenous Technical Knowledge in Pest Management. National Centre for Integrated Pest Management, Indian Council of Agricultural Research, New Delhi; c2005. p. 5.
6. Khanzada KK, Khanzada B, Chandio HR, Sipio AF, Jat IM. Evaluation of insecticides against insect-pests on Chillies, *Capsicum annum* L. and their management. International Journal of Zoological Studies. 2018;3(5):5-15.
7. Mahmoud MF. Combining the botanical insecticides NSK extract, NeemAzal T 5%, Neemix 4.5% and the entomopathogenic nematode *Steinernema feltiae* Cross N 33 to control the peach fruit fly, *Bactrocera zonata* (Saunders). Plant Protection Science. 2007;43(1):19.
8. Meena H, Singh SP, Nagar R. Evaluation of microbial agents and bio-products for the management of mustard aphid, *Lipaphis erysimi* (Kalt.). The Bioscan. 2013;8(3):747-750.
9. Pandey A. Study on insect pest complex of chilli and their management. M.Sc. thesis, Submitted to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India; c2014.
10. Pandey SK, Mathur AC, Srivastava M. Management of Leaf curl disease of Chilli (*Capsicum annuum* L.). International Journal of Virology. 2010;6(4):246-250.
11. Pathipati VL, Singh TVK, Vemuri SB, Reddy SK, Bharathi NB. Survey on insect pest complex and bioefficacy of certain insecticide molecules against

aphids, *Myzus persicae* (Sulz.) on capsicum under poly house conditions. Pest Management in Horicultural Ecosystems. 2017;23(1):17-26.
12. Rana BS, Ahir KC, Sonkamble MM, Desai SD. Bioefficacy of Imidacloprid 350 SC against sucking insect-pests in chilli (*Capsicum annum* L.). Journal of Applied Natural Sciences. 2016;8(4):1815-1820.
13. Roopa M, Kumar CTA. Seasonal incidence of pests of Capsicum in Bangalore conditions of Karnataka, India. Global Journal of Biology, Agriculture and Health Sciences. 2014;3(3):203-207.
14. Samota RG, Jat BL, Choudhary MD. Efficacy of newer insecticides and biopesticides against thrips, *Scirtothrips dorsalis* Hood in chilli. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1458-1462.
15. Sapkota R, Dahal KC, Thapa RB. Damage assessment and management of cucurbit fruit flies in spring-summer squash. Journal of Entomology and Nematology. 2010;2(1):007-012.
16. Shafie EHAF, Abdelraheem BA. Field Evaluation of Three Biopesticides for Integrated Management of Major Pests of Tomato, *Solanum lycopersicum* L. in Sudan. Agriculture and Biology Journal of North America. 2012;3(9):340-344.
17. Tesfaye A, Gautam RD. Traditional pest management practices and lesser exploited natural products in Ethiopia and India: Appraisal and revalidation. Indian Journal of Traditional Knowledge. 2003;2(2):189-201.
18. Thangjam R, Borah RK, Saikia DK. Pest complex of king chilli, *Capsicum Chinense* Jacquine in Assam, north-east India. The Bioscan. 2017;12(4):2069-2073.
19. Tukaram VC, Karnatak AK, Srivastava RM. Bioefficacy of newer insecticide molecules against pest complex of chilli. Octa Journal of Environmental Research. 2017;5(2):129-139.
20. Vanisree K, Upendhar S, Rajasekhar P, Rao GR, Rao VS. Effect of newer insecticides against chilli thrips, Scirtothrips dorsalis (Hood). Journal of Entomology and Zoological Studies. 2017;5(2):277-284.