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Efficacy of panchagavya and botanical pesticides against diamondback moth (*Plutella xylostella* L.) on cabbage

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Abstract

Diamondback moth is the major pest that attack on cabbage and reduce marketable yield. In the present study efficacy of panchagavya and botanical pesticides was evaluated at different intervals against *P. xylostella*, all the treatments were significantly superior over untreated control. Minimum larval population was recorded in Spinosad 45 SC @ 0.1 ml/ l followed by Panchagavya 10% + NSKE 5% and Panchagavya 5% + NSKE 5%. All these treatments were at par with each other and significantly superior to rest of the treatments. The treatment of Panchagavya 10% + Tumba extract 5% followed by Panchagavya 10% + Tulsi leaf extract 10%, Panchagavya 10% + Cow urine 10% and Panchagavya 5% + Tumba extract 5% were comprised the next effective group of treatments and proved moderate efficacy. However, highest population was recorded in Panchagavya 10% alone, Panchagavya 5% + Cow urine 10% and Panchagavya 5% + Tulsi leaf extract 10%. All these treatments were comparable and significantly inferior to rest of the treatments except control.

Keywords: Botanical, diamondback moth, NSKE, panchagavya, *Plutella xylostella*, significant, Tulsi extract, tumba extract, treatment

Introduction

Cabbage is most important in terms of nutritional and economic significance and grows in winter season. In the world China ranks first in cabbage production followed by India. In India area and production being 0.403 lakh hectare and 93.69 million tones, respectively (Anonymous, 2019) [3]. In Rajasthan, the area and production under cabbage was 12000 hectares and 11690 metric tonnes, respectively (Anonymous, 2017-18) [2].

Different insect pests pose threat to the production of cabbage throughout the world. Maison (1965) [7] listed 51 insect pests which damage cruciferous crops throughout the world out of which diamondback moth (DBM), *Plutella xylostella* (Linnaeus); (Lepidoptera : Plutellidae) is one of the major constraints in the profitable cultivation of cole crops, wherever they are grown (Talekar and Shelton 1993) [15]. It was estimated that at least 53-80 percent loss in marketable yield is due to *Plutella xylostella* (Chelliah and Srinivasan, 1986) [5].

In order to prevent the loss caused by insects and produce a quality crop, it is essential to manage the pest population at appropriate time with suitable measures. Economic significance of the cabbage crops compelled the vegetable growers to use more frequent insecticide applications of recommended and non-recommended chemicals for eliminating the pest population and try to fetch better marketable yields.

Use of excessive and indiscriminate dosages of conventional insecticides posed severe problems such as, adverse effect on non-target organisms, development of resistance in target pest and pest resurgence. Hazardous implications of these pesticides and their residues at various tropic levels have also caused incalculable damage to every aspect of environment, globally. Amit *et al.* (2018) [1] reported that the greatest challenge facing by the nation in the coming years is to demand safe food for the growing population in the country. Inspired by this, organic farming which leads to improving the health of agroecosystem has gained wide detection as a valid alternative to conventional food products and confirms safe food for human consumption. Therefore, it is necessary to use natural products like panchagavya to produce residue free food crops and hence panchagavya can play a major role in organic farming (Kumar *et al.* 2018) [6] once again made the researcher to bring various eco-friendly management strategies of *Plutella xylostella* into frontline. Keeping this in mind present studies has initiated to identify eco-friendly Integrated Pest Management (IPM) strategy for

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diamondback moth on cabbage.

Materials and Methods

The field experiment was conducted in randomized block design at Instructional Farm, College of Agriculture, S.K.R.A.U., Bikaner during *rabi*, (2018-19 and 2019-20), using cabbage variety Golden Acre grown following recommended practices. Evaluation of panchagavya and botanicals against *P. xylostella* with the treatments being: T₁- Panchagavya 5% + NSKE 5%, T₂- Panchagavya 10% + NSKE 5%, T₃- Panchagavya 10% alone, T₄- Panchagavya 5% + Cow urine 10%, T₅- Panchagavya 10% + Cow urine 10%, T₆- Panchagavya 5% + Tulsi Leaf extract 10%, T₇- Panchagavya 10% + Tulsi Leaf extract 10%, T₈- Panchagavya 5% + Tumba extract 5%, T₉- Panchagavya 10% + Tumba extract 5%, T₁₀- Spinosad 45 SC @ 0.1 ml/ L, and T₁₁- Untreated control. All the treatments were replicated thrice, with plot size of 2.25 m X 1.8 m. The treatments were imposed during one standard hole of size 0.5 to 1.00 cm in diameter is taken as the visual damage threshold for insecticide application (Lingappa *et al.*, 2004) [8] with a pneumatic knapsack sprayer using 500 l of spray fluid/ ha. Observation on number of larva were recorded from five randomly selected plant from each plot before application of insecticides and 1, 3, 7 and 10 days after spraying. The Data on the population of diamondback moth larvae recorded were analyzed after transforming into square root transformation.

Results and Discussion

Year 2018-2019 and 2019-2020

The results reveal that before spray of the treatment difference in larval population of *P. xylostella* varied between 1.93 to 2.31 and 1.51 to 1.81 larvae per plant during both year and was statistically not significant.

One day after spray

The pooled data of all the three sprays presented in table 1 and 2 revealed that minimum larval population of *P. xylostella* was recorded in Spinosad 45 SC @ 0.1 ml/ l (0.93 and 0.87 larvae/ plant) which was found at par with Panchagavya 10% + NSKE 5% (1.02 and 0.94 larvae/ plant) and Panchagavya 5% + NSKE 5% (1.09 and 1.03 larvae/ plant) one day after treatments during both year. The next order of effectiveness was Panchagavya 10% + Tumba extract 5% (1.56 and 1.47 larvae/ plant) which was found at par with Panchagavya 10% + Tulsi leaf extract 10% (1.66 and 1.53 larvae/ plant), Panchagavya 10% + Cow urine 10% (1.72 and 1.58 larvae/ plant) and Panchagavya 5% + Tumba extract 5% (1.81 and 1.64 larvae/ plant). Maximum larval population was recorded in Panchagavya 10% alone (2.51 and 2.30 larvae/ plant), Panchagavya 5% + Cow urine 10% (2.43 and 2.20 larvae/ plant) and Panchagavya 5% + Tulsi leaf extract 10% (2.36 and 2.13 larvae/ plant) also did not differ significantly with respect to efficacy against *P. xylostella* during both year.

Table 1: Efficacy of different ecfriendly pesticides against larval population of *P. xylostella* on cabbage during 2018-19 (Pooled)

Treatment	* Mean larval population per plant				
	Before spray	1 DAS	3 DAS	7 DAS	10 DAS
Panchagavya 5% + NSKE 5%	2.31 (1.68)	1.09(1.26)	0.62(1.06)	0.51(1.00)	0.90(1.18)
Panchagavya 10% + NSKE 5%	2.30 (1.67)	1.02(1.23)	0.55(1.03)	0.46(0.98)	0.82(1.15)
Panchagavya 10% alone	2.13 (1.62)	2.51(1.73)	1.81(1.52)	1.40(1.38)	2.24(1.66)
Panchagavya 5% + Cow urine 10%	2.13 (1.62)	2.43(1.71)	1.73(1.49)	1.31(1.35)	2.06(1.60)
Panchagavya 10% + Cow urine 10%	2.24 (1.66)	1.72(1.49)	1.13(1.28)	0.84(1.16)	1.41(1.38)
Panchagavya 5% + Tulsi Leaf extract 10%	2.13 (1.62)	2.36(1.69)	1.65(1.47)	1.26(1.33)	2.00(1.58)
Panchagavya 10% + Tulsi Leaf extract 10%	2.31 (1.68)	1.66(1.47)	1.07(1.25)	0.79(1.13)	1.34(1.36)
Panchagavya 5% + Tumba extract 5%	2.31 (1.68)	1.81(1.52)	1.18(1.30)	0.91(1.19)	1.50(1.42)
Panchagavya 10% + Tumba extract 5%	1.93 (1.56)	1.56(1.44)	1.00(1.22)	0.75(1.12)	1.30(1.34)
Spinosad 45 SC @ 0.1 ml/ L	2.31 (1.68)	0.93(1.19)	0.39(0.94)	0.45(0.97)	0.80(1.14)
Control (Untreated)	2.24 (1.66)	3.87(2.09)	4.09(2.14)	5.11(2.37)	4.44(2.22)
S.Em ±	-	0.04	0.04	0.02	0.05
C.D.	NS	0.12	0.11	0.05	0.14
C.V%	NS	8.57	8.66	8.89	8.12

*Figures in parentheses are retransformed values, while those outside $\sqrt{X} + 0.5$ transformed values
DAS: Day(s) after spray. NS: Non-significant

Three days after spray

The data recorded three days after spray revealed that Spinosad 45 SC @ 0.1 ml/ l treatment had lowest larval population of (0.39 and 0.28 larvae/ plant) and was at par with Panchagavya 10% + NSKE 5% (0.55 and 0.50 larvae/ plant) and Panchagavya 5% + NSKE 5% (0.62 and 0.58 larvae/ plant). Further, Panchagavya 10% + Tumba extract 5% (1.00 and 0.94 larvae/ plant) was observed comparable with Panchagavya 10% + Tulsi leaf extract 10% (1.07 and 1.0 larvae/ plant), Panchagavya 10% + Cow urine 10% (1.13 and 1.06 larvae/ plant) and Panchagavya 5% + Tumba extract 5% (1.18 and 1.14 larva/ plant). The treatments of Panchagavya 5% + Tulsi leaf extract 10% (1.65 and 1.66 larvae/ plant), Panchagavya 5% + Cow urine 10% (1.73 and 1.76 larvae/ plant) and Panchagavya 10% alone (1.81 and 1.85 larvae/

plant) were found least effective and recorded highest larval population of *P. xylostella* during both year.

Seven days after spray

It becomes evident from the data on larval population of *P. xylostella* that seven days after spray lowest efficacy was recorded in Panchagavya 10% alone (1.40 and 1.21 larvae/ plant), Panchagavya 5% + Cow urine 10% (1.31 and 1.15 larvae/ plant) and Panchagavya 5% + Tulsi leaf extract 10% (1.26 and 1.11 larvae/ plant), which were at par to each other. Whereas, the highest efficacy was recorded in Spinosad 45 SC @ 0.1 ml/ l (0.45 and 0.36 larvae/ plant) followed by Panchagavya 10% + NSKE 5% (0.46 and 0.38 larvae/ plant) and Panchagavya 5% + NSKE 5% (0.51 and 0.46 larvae/ plant). Though, Panchagavya 10% + Tumba extract 5% (0.75

and 0.69 larvae/ plant) was found at par with Panchagavya 10% + Tulsi leaf extract 10% (0.79 and 0.73 larvae/ plant), Panchagavya 10% + Cow urine 10% (0.84 and 0.77 larvae/ plant) and Panchagavya 5% + Tumba extract 5% (0.91 and 0.80 larvae/ plant) during both year.

Ten days after spray

The results on efficacy of these treatments at ten days after spray clearly indicated minimum larval population per plant was recorded in Spinosad 45 SC @ 0.1 ml/ l (0.80 and 0.51 larvae/ plant), Panchagavya 10% + NSKE 5% (0.82 and 0.57 larvae/ plant) and Panchagavya 5% + NSKE 5% (0.90 and 0.70 larvae/ plant) were found at par with each other and most effective treatments during both year. In order of the effectiveness Panchagavya 10% + Tumba extract 5% (1.30 and 1.18 larvae/ plant) was found at par with Panchagavya 10% + Tulsi leaf extract 10%, Panchagavya 10% + Cow urine 10% and Panchagavya 5% + Tumba extract 5% (1.34 and 1.85 larvae/ plant), (1.41 and 1.28 larvae/ plant) and (1.50 and 1.33 larvae/ plant), respectively and were found moderately effective. However, least effective and maximum larval population were recorded in Panchagavya 10% alone (2.24 and 1.96 larvae/ plant) which was at par with Panchagavya 5% + Cow urine 10% (2.06 and 1.88 larvae/ plant) Panchagavya 5% + Tulsi leaf extract 10% (2.00 and 1.85 larvae/ plant) during both year.

Pooled (2018-2019 & 2019-2020)

The overall efficacy of different insecticides evaluated at different intervals against *P. xylostella* for individual years and pooled mean presented in (Table 3) evidenced that all the treatments were significantly superior over untreated control. Minimum larval population was recorded in Spinosad 45 SC @ 0.1 ml/ l (0.58 larvae/ plant) followed by Panchagavya

10% + NSKE 5% (0.66 larvae/ plant) and Panchagavya 5% + NSKE 5% (0.75 larvae/ plant). All these treatments were at par with each other and significantly superior to rest of the treatments. The treatment of Panchagavya 10% + Tumba extract 5% (1.12 larvae/ plant) followed by Panchagavya 10% + Tulsi leaf extract 10%, Panchagavya 10% + Cow urine 10% and Panchagavya 5% + Tumba extract 5% (1.18, 1.24 and 1.30 larvae/ plant, respectively) were comprised the next effective group of treatments and proved moderate efficacy. However, highest population was recorded in Panchagavya 10% alone (1.93 larvae/ plant), Panchagavya 5% + Cow urine 10% (1.83 larvae/ plant) and Panchagavya 5% + Tulsi leaf extract 10% (1.77 larvae/ plant). All these treatment were comparable and significantly inferior to rest of the treatments except control (4.22 larvae/ plant).

In past Rahimgul and Sasya (2016) [13] recorded the maximum percent reduction (49.45%) of *P. xylostella* on cabbage with the use of Spinosad 45 SC as compared to other organics and botanical insecticides. Similarly, Pazhanisamy and Archunan (2019) [10] reported highest per cent reduction of *E. vittella* with panchagavya (3%) + Neem Seed Kernel Extract (NSKE) (5%) treated plot followed by pungam oil 3% + panchagavya 3% and Neem Leaf Extract (NLE) 5% + panchagavya 3%. They also observed that NSKE 5% in combination with panchagavya were effective in the management of *E. vittella* and could be potential alternative to synthetic pesticides confirm the present studies. Similar results also recorded by Meena *et al.* (2016) [9], Shailaja *et al.* (2012) [14], Patel *et al.* (2003) [11], More *et al.* (1989) [12] and Chandrashekharaiah and Sannaveerappanavar (2013) [4] who reported the low replency of *P. xylostella* with the use of panchagavya alone as compared to panchagavya used in combination with other botanicals and cow urine.

Table 2: Efficacy of different ecofriendly pesticides against larval population of *P. xylostella* on cabbage during 2019-20 (Pooled)

Treatment	* Mean larval population per plant				
	Before spray	1 DAS	3 DAS	7 DAS	10 DAS
Panchagavya 5% + NSKE 5%	1.79 (1.51)	1.03(1.24)	0.58(1.04)	0.46(0.98)	0.70(1.10)
Panchagavya 10% + NSKE 5%	1.63 (1.46)	0.94(1.20)	0.50(1.00)	0.38(0.94)	0.57(1.04)
Panchagavya 10% alone	1.83 (1.53)	2.30(1.67)	1.85(1.53)	1.21(1.31)	1.96(1.57)
Panchagavya 5% + Cow urine 10%	1.79 (1.51)	2.20(1.64)	1.76(1.50)	1.15(1.28)	1.88(1.54)
Panchagavya 10% + Cow urine 10%	1.72 (1.49)	1.58(1.44)	1.06(1.25)	0.77(1.13)	1.28(1.33)
Panchagavya 5% + Tulsi Leaf extract 10%	1.73 (1.49)	2.13(1.62)	1.66(1.47)	1.11(1.27)	1.85(1.53)
Panchagavya 10% + Tulsi Leaf extract 10%	1.76 (1.50)	1.53(1.43)	1.00(1.22)	0.73(1.11)	1.22(1.31)
Panchagavya 5% + Tumba extract 5%	1.76 (1.50)	1.64(1.46)	1.14(1.28)	0.80(1.14)	1.33(1.35)
Panchagavya 10% + Tumba extract 5%	1.59 (1.45)	1.47(1.40)	0.94(1.20)	0.69(1.09)	1.18(1.30)
Spinosad 45 SC @ 0.1 ml/ L	1.81 (1.52)	0.87(1.17)	0.28(0.88)	0.36(0.93)	0.51(1.01)
Control (Untreated)	1.80 (1.52)	3.79(2.07)	3.75(2.06)	4.03(2.13)	3.95(2.11)
S.Em ±	-	0.06	0.05	0.03	0.05
C.D.	NS	0.18	0.15	0.10	0.13
C. V.%	NS	8.24	9.96	8.53	9.38

*Figures in parentheses are retransformed values, while those outside $\sqrt{X} + 0.5$ transformed values
DAS: Day(s) after spray. NS: Non-significant

Table 3: Efficacy of various ecofriendly pesticides against larval population of *P. xylostella* on cabbage (Pooled)

Treatment	* Mean larval population per plant								Pooled 2018 -2019 & 2019-2020
	2018-2019				2019-2020				
	I Spray	II Spray	III Spray	Average over three sprays	I Spray	II Spray	III Spray	Average over three sprays	
Panchagavya 5% + NSKE 5	0.57(1.03)	0.64(1.06)	1.16(1.29)	0.79(1.13)	0.56(1.03)	0.79(1.13)	0.75(1.11)	0.70(1.09)	0.75(1.11)
Panchagavya 10% + NSKE 5	0.53(1.01)	0.58(1.03)	1.08(1.25)	0.73(1.10)	0.48(0.99)	0.67(1.08)	0.66(1.07)	0.60(1.04)	0.66(1.07)
Panchagavya 10% alone	1.62(1.45)	1.78(1.50)	2.64(1.77)	2.01(1.57)	1.49(1.41)	2.03(1.59)	2.01(1.57)	1.84(1.52)	1.93(1.55)
Panchagavya 5% + Cow urine 10%	1.52(1.41)	1.68(1.47)	2.51(1.73)	1.90(1.54)	1.42(1.38)	1.93(1.55)	1.92(1.54)	1.76(1.49)	1.83(1.52)
Panchagavya 10% + Cow urine 10%	0.99(1.21)	1.13(1.27)	1.75(1.49)	1.29(1.33)	0.96(1.20)	1.29(1.33)	1.29(1.33)	1.18(1.29)	1.24(1.31)
Panchagavya 5% + Tulsi Leaf extract 10%	1.46(1.39)	1.62(1.45)	2.44(1.71)	1.84(1.52)	1.37(1.36)	1.87(1.53)	1.85(1.52)	1.70(1.47)	1.77(1.49)
Panchagavya 10% + Tulsi Leaf extract 10	0.93(1.19)	1.07(1.25)	1.70(1.48)	1.23(1.30)	0.92(1.19)	1.23(1.31)	1.23(1.30)	1.13(1.27)	1.18(1.29)
Panchagavya 5% + Tumba extract 5%	1.06(1.24)	1.20(1.30)	1.84(1.53)	1.37(1.35)	1.00(1.22)	1.36(1.36)	1.35(1.35)	1.23(1.31)	1.30(1.33)
Panchagavya 10% + Tumba extract 5%	0.88(1.17)	1.00(1.22)	1.63(1.45)	1.17(1.28)	0.86(1.16)	1.20(1.30)	1.18(1.29)	1.08(1.25)	1.12(1.26)
Spinosad 45 SC @ 0.1 ml/ L	0.50(0.99)	0.52(1.00)	0.94(1.19)	0.65(1.06)	0.40(0.95)	0.58(1.03)	0.54(1.01)	0.51(1.00)	0.58(1.03)
Control (Untreated)	3.20(1.91)	4.27(2.18)	5.86(2.52)	4.44(2.21)	2.27(1.66)	4.18(2.16)	5.52(2.45)	3.99(2.09)	4.22(2.15)
S.Em ±	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.05
C.D.	0.13	0.15	0.16	0.15	0.13	0.16	0.16	0.15	0.15
C.V.%	8.97	8.50	8.22	8.56	8.69	9.61	8.78	9.02	8.79

*Figures in parentheses are retransformed values, while those outside $\sqrt{X} + 0.5$ transformed values

DAS: Day(s) after spray. NS: Non-significant

Conclusion

The overall efficacy of different ecofriendly pesticides evaluated at different intervals against *P. xylostella* for individual year. The minimum larval population was recorded in Spinosad 45 SC @ 0.1 ml/ l followed by Panchagavya 10% + NSKE 5% and Panchagavya 5% + NSKE 5% proved the higher efficacy. The treatment of Panchagavya 10% + Tumba extract 5% followed by Panchagavya 10% + Tulsi leaf extract 10%, Panchagavya 10% + Cow urine 10% and Panchagavya 5% + Tumba extract 5% were comprised the next effective group of insecticide and proved moderate efficacy. However, highest population was recorded in Panchagavya 10% alone, Panchagavya 5% + Cow urine 10% and Panchagavya 5% + Tulsi leaf extract 10%.

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