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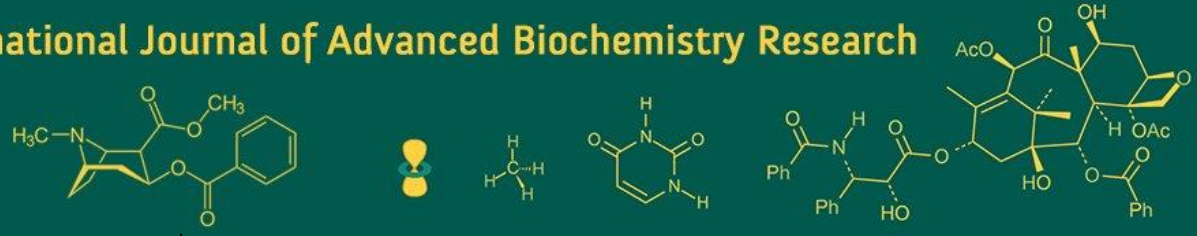

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Comparative efficacy of aqueous and ethanolic *Dashparni* extracts against cotton aphid (*Aphis gossypii*)

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Abstract
An experiment including aqueous and ethanolic *Dashparni* leaf extracts has been conducted to evaluate their efficacy against aphid on cotton. The results revealed that most superior treatment for management of aphid on cotton was *Dashparni* extract (45 days old) followed by *Dashparni* extract (30 days old), fermented *Dashparni* extract (15 days old), *Dashparni* extract, petroleum ether *Dashparni* extract, and fresh *Dashparni* extract which was statistically at par with each other. The highest aphid population was noticed in untreated plot. Overall, the results suggest that fermented Dashparni extract, especially the 45-day fermented version, shows great promise as a natural, eco-friendly pest control solution for cotton crops. This could offer a sustainable alternative to harmful synthetic pesticides, mitigating environmental risks and promoting greener agricultural practices.

Keywords: Cotton aphid, *Dashparni* ark, botanicals, efficacy

Introduction
As a major commercial crop, cotton plays a significant role in the global economy and provides employment opportunities for millions. It produces fiber, oil, and protein. Earning its nicknames "King of natural fibers" and "White gold" cotton is a highly valuable cash crop. Cotton faces significant threats from main pest groups: sucking insects. Sucking pests include aphid (*Aphis gossypii*), jassids (*Amrasca biguttula biguttula*), thrips (*Thrips tabaci*), and whitefly (*Bemisia tabaci*) are the major culprits in this category, damaging the plant by sucking its sap. The losses in cotton due to sucking pests been reported as 11.60% (Dhawan and Sindhu 1986) [1]. Farmers are mostly relying on insecticidal spray which is hazardous to environment. So, it is high time to search some alternative or complementary management tactics for the management sucking pests. India's traditional agriculture has demonstrated its sustainability by preserving the country's fertility and biodiversity for centuries (Roychoudhury, 1964) [1]. Leaves from various plants, including Neem (*Azadirachta indica*), Nirgudi (*Vitex negundo*), Karanj (*Pongamia pinnata)*, Supla (*Mundulea sericea*), Tun (*Toona ciliate*), Teak (*Tectona grandis*), young leaves of Komal (*Koelzell apadularia*), Bhang (*Cannabis sativa*), and Metho Dodi (*Leptadenia reticulate*), have been traditionally used in many states. Additionally, wood ash from plants like Babhul (*Acacia nilotica*), Suru (*Casurina equisitifolia*), Mango (*Mangifera indica*), and Tamarand (*Tamarindus indica*) has been employed. In certain regions, powdered rhizomes of sweet flag (*Acorus calamus*) or turmeric (*Curcuma longa*) are used to safeguard crops from pest attacks (Kulkarni and Kumbhojkar, 2003) [6].
Dashparni ark is a highly effective organic biopesticide utilized in pest management. It is prepared using a diverse array of natural ingredients, including plant leaves. In standard practice, this mixture undergoes fermentation for approximately 40 days, culminating in a potent solution capable of controlling a broad spectrum of pests and diseases in crops (Kasarkar *et al.*, 2021) [4]. While biopesticides offer numerous advantages, they also exhibit certain limitations. Compared to synthetic pesticides, biopesticides often possess a shorter shelf life, which can impact their availability and effectiveness. Biomass or bioactive metabolites can be degraded by factors such as air, light and temperature (Hernandez *et al.*, 2022) [3].

The current investigations were conducted to assess aqueous and ethanolic *dashparni* leaf extracts against aphid within the cotton ecosystem

Materials and Methods

The field experiment was conducted in a randomized block design with eight treatments including untreated control replicated thrice at the farm of Department of Agricultural Entomology, College of agriculture, Latur during *Kharif* season 2023. RCH-779 BG II cotton hybrid was sown at 120 x 45 cm spacing on 15 July 2023. The treatment includes Fresh *Dashparni* extract (T_1), Decoction *Dashparni* extract (T_2), Ethyl acetate *Dashparni* extract (T_3), Pertolium ether *Dashparni* extract (T_4), Fermented *Dashparni* extract (15 days old) (T_5), Fermented *Dashparni* extract (30 days old) (T_6), Fermented *Dashparni* extract (45 days old) (T_7) and Control (Water spray) (T_8). The details of ingredients and preparation procedure is as below.

Table 1: Ingredients of *Dashparni* leaf extract

Sr. No.	Name of plant	Botanical Name	Quantity (For 1 acre)
1	Neem	*Azadirachta indica*	5 Kg
2	Papaya	*Carica papaya*	2 Kg
3	Custard apple	*Annona squamosa*	2 Kg
4	Karanj	*Pongamia pinnata*	2 Kg
5	Castor	*Ricinus communis*	2 Kg
6	Nirgudi	*Vitex negundo*	2 Kg
7	Kanheri	*Nerium indicum*	2 Kg
8	Ghaneri	*Lantena camera*	2 Kg
9	Ruchaki/giant milkweed	*Calatropis procera*	2 Kg
10	Gulvel	*Tinospora cordifolia*	2 Kg
11	Green chilli paste	*Capsicum annum*	2 Kg
12	Garlic paste	*Allium sativum*	250 g
13	Cow dung	--	3 Kg
14	Cow urine	--	5 lit.
15	Water	--	200 lit.

(NITI Aayog, 2021)

Fresh *Dashparni* leaf extract: All of the aforementioned ingredients were placed in a 500-liter container. The ingredients were crushed and added to 200 liters of water. The mixture was then left overnight. The following day, the solution was filtered and used for spraying.

Decoction *Dashparni* leaf extract: All of the aforementioned ingredients were placed in a 500-liter container. The ingredients were crushed and added to 200 liters of water. The mixture was heated or simmered for 60 minutes and then left overnight. The following day, the solution was filtered and used for spraying.

Ethyl acetate or Petroleum ether *Dashparni* leaf extract: The aforementioned ingredients were collected, cleaned, and air-dried. Once dried, they were ground into a fine powder. The powdered ingredients were soaked in ethyl acetate or petroleum ether using a 1:10 weight-to-volume ratio to extract various phytochemicals. This mixture was left overnight. After the extraction period, the mixture was filtered to separate the liquid extract from the solid material. The filtrate was then concentrated, using a rotary evaporator, to remove the solvent and obtain a concentrated extract. This extract was mixed with 200 liters of water and used for spraying (Panneerselvam *et al.*, 2013) [8].

Fermented *Dashparni* leaf extract: The ingredients were crushed and placed in a 500-liter drum for fermentation. The drum was kept in a shaded area, covered with a gunny bag, and shaken regularly three times a day. After the 15, 30 and 45 days, the extract was crushed and filtered. The resulting filtrate was used for spraying.

For recording counts of aphids, five plants were selected randomly in each plot and were tagged. From such tagged plants, the pest population on three leaves, one each from top, middle and bottom were recorded. Pre-count was taken at one day before spraying and post counts were recorded on 1, 3, 7 and 14 days after spraying. The data tabulated on population of aphids were subjected to appropriate transformation and analyzed using OPSTAT software (Sheoran *et al.*, 1998) [13]. The data was analyzed statistically using standard analysis of variance (ANOVA) methods as suggested by Panse and Sukhatme (1961) [9]. The variance attributed to treatments was compared against the error variance to test the null hypotheses.

Results and Discussion

Three sprayings were conducted; first on 15 September, second on 5 October and third on 25 October 2023.

First Spray

The population of aphid was recorded before and after first spraying and is presented in Table 2.

There was no statistically significant difference in the pre count of aphid populations. One day after spraying (DAS), the lowest aphid population was observed in the 45-day-old fermented Dashparni extract treatment (17.06 aphids per 3 leaves). This was followed by the 30-day-old fermented extract (18.97 aphids per 3 leaves), the 15-day-old fermented extract (19.83 aphids per 3 leaves), ethyl acetate Dashparni extract (20.10 aphids per 3 leaves), petroleum ether Dashparni extract (20.47 aphids per 3 leaves), fresh Dashparni extract (21.77 aphids per 3 leaves), and decoction Dashparni extract (22.30 aphids per 3 leaves). The untreated control had the highest aphid population (24.90 aphids per 3 leaves). Three days after spraying (DAS), the lowest aphid populations were observed in the 45-day-old fermented Dashparni extract treatment (11.80 aphids per 3 leaves), followed by the 30-day-old fermented extract (12.14 aphids per 3 leaves). The 15-day old fermented Dashparni extract also showed lower aphid numbers (13.20 aphids per 3 leaves). In contrast, the decoction Dashparni extract had significantly higher aphid populations (17.80 aphids per 3 leaves) among all extracts. Similar results were observed seven days after spraying. On Day 14, the aphid population was lowest in the treatment of fermented Dashparni extract (aged 45 days), followed by fermented Dashparni extracts aged 30 and 15 days. In contrast, the untreated control and the decoction of Dashparni extract exhibited significantly higher aphid populations. On average, fermented Dashparni extract (aged 45 days) demonstrated the strongest efficacy against aphids, with an average of 15.26 aphids per three leaves. Fermented extracts aged 30 and 15 days also exhibited notable effectiveness, followed by ethyl acetate and petroleum ether extracts. Fresh Dashparni extract and decoction were less effective than the fermented extracts. The untreated control recorded the highest aphid population. Compared to the untreated control, the 45-day-old fermented Dashparni extract 34 35 demonstrated the highest reduction in aphid population, achieving a 42.45% decrease.

Fermented extracts aged 30 and 15 days also showed significant reductions, followed by ethyl acetate and petroleum ether extracts. Fresh Dashparni extract and decoction had lower reduction rates, with the decoction exhibiting the lowest reduction at 12.78%.

Second Spray

The observations on aphid population before and after the second spraying are presented in Table 3. The precount of aphids was significantly lowest in the treatment of fermented *Dashparni* extract (45 days old) (11.30/3 leaves), followed by fermented *Dashparni* extract (30 days old) (11.33/3 leaves) and fermented *Dashparni* extract (15 days old) (11.50/3 leaves). Among all extracts, the highest population was observed in decoction *Dashparni* extract (14.50/3 leaves).

On 1 DAS, the aphid population was recorded to be lowest in the treatment of fermented *Dashparni* extract (45 days old) (8.77/3 leaves), which was comparable to fermented *Dashparni* extract (30 days old) (8.90/3 leaves), fermented *Dashparni* extract (15 days old) (9.45/3 leaves), ethyl acetate *Dashparni* extract (10.30/3 leaves), and petroleum ether *Dashparni* extract (10.60/3 leaves). Among the extracts, the highest population was observed in decoction *Dashparni* extract (12.25/3 leaves). The untreated control recorded the maximum aphid population in all treatments.

On 3 and 7 DAS, the aphid population was lowest in the treatments of fermented *Dashparni* extract (45 days old) and fermented *Dashparni* extract (30 days old). These were followed by fermented *Dashparni* extract (15 days old) and ethyl acetate *Dashparni* extract. A similar trend was observed on 14 DAS as well.

The average aphid population after the second spraying revealed that the most effective treatment against aphids was fermented *Dashparni* extract (45 days old) (7.39/3 leaves), followed by fermented *Dashparni* extract (30 days old) (7.93/3 leaves), fermented *Dashparni* extract (15 days old) (8.56/3 leaves), ethyl acetate *Dashparni* extract (9.29/3 leaves), petroleum ether *Dashparni* extract (9.61/3 leaves), and fresh *Dashparni* extract (11.06/3 leaves). Decoction *Dashparni* extract (11.58/3 leaves) was less effective compared to the aforementioned treatments. The untreated control recorded the highest aphid population in all treatments (14.61/3 leaves).

The highest reduction of aphid population compared to the control was achieved by spraying 45 days old fermented *Dashparni* extract (49.52%). It was followed by 30 days old fermented *Dashparni* extract (45.83%), 15 days old fermented *Dashparni* extract (41.53%), ethyl acetate *Dashparni* extract (36.54%), petroleum ether *Dashparni* extract (34.35%), and fresh *Dashparni* extract (24.45%). The lowest reduction was observed in decoction *Dashparni* extract (20.90%).

Third Spray

According to the data presented in Table 4, Fermented *Dashparni* extract (45 days old) exhibited the most significant reduction in aphid precount (13.30/3 leaves). Fermented *Dashparni* extracts aged 30 and 15 days also showed lower aphid populations (14.20 and 14.60/3 leaves, respectively). In contrast, decoction *Dashparni* extract had the highest aphid population (18.60/3 leaves), while the untreated check experienced the largest infestation (201.13/3 leaves).

On the first day after treatment (1 DAS), the lowest aphid populations were observed in the treatments of fermented *Dashparni* extract (45 days old) (9.70/3 leaves), fermented *Dashparni* extract (30 days old) (10.05/3 leaves), fermented *Dashparni* extract (15 days old) (10.90/3 leaves), ethyl acetate *Dashparni* extract (12.10/3 leaves), and petroleum ether *Dashparni* extract (12.67/3 leaves). Among the extracts, decoction *Dashparni* extract had the highest aphid population (13.67/3 leaves). The untreated check (18.36/3 leaves) recorded the maximum aphid population in all treatments. Similar trend was noticed on 3, 7 and 14 DAS also.

The average data indicated that fermented *Dashparni* extract (45 days old) was the most effective treatment against aphids (8.93/3 leaves), followed by fermented *Dashparni* extract (30 days old) (9.43/3 leaves), fermented *Dashparni* extract (15 days old) (10.17/3 leaves), ethyl acetate *Dashparni* extract (12.22/3 leaves), petroleum ether *Dashparni* extract (14.05/3 leaves), and fresh *Dashparni* extract (13.82/3 leaves). Decoction *Dashparni* extract (14.48/3 leaves) was less effective than the aforementioned treatments. The untreated check (19.56/3 leaves) had the highest aphid population.

Fermented *Dashparni* extract (45 days old) demonstrated the highest reduction in aphid population compared to the control (54.34%), followed by fermented *Dashparni* extract (30 days old) (51.78%), fermented *Dashparni* extract (15 days old) (48.01%), ethyl acetate *Dashparni* extract (37.52%), petroleum ether *Dashparni* extract (33.28%), fresh *Dashparni* extract (29.34%), and decoction *Dashparni* extract (25.97%).

The fermented extract of Dashparni (45 days old) was the most effective. It significantly reduced populations of aphids. The pesticidal properties of Dashparni extract appear to be enhanced by the fermentation process. The extract fermented for 45 days was more effective than the extract fermented for 30 days or for 15 days. The solvent used to extract the active compounds from dashparni leaves also played a role. Ethyl acetate and petroleum ether extracts were moderately effective, while fresh and decoction extracts were less effective. The decoction extract, prepared by boiling the leaves in water, was the least effective against both sucking pests and bollworms. This suggests that the active compounds may be degraded or lost during the boiling process.

Sharma *et al.*, (2014) [12] found that for mustard aphid 10% aqueous leaf extract of *Polygonum hydropiper* followed by panchgavya 10% and *Dashparni* 5% respectively effective in aphid control. Rajput *et al.*, (2017) observed the spray of three local extracts such as tobacco [10] *Nicotiana tabacium*), neem (*Azadirachtin indica*) and datura (*Datura stramonium*) on cotton the overall results showed highest pest population reduction at tobacco (17.45-15.09%) followed by neem (14.58-15.33%) and datura (11.72-7.81%) and similar trend was also noted in the second year of the study. Kharbade *et al.* (2012) [5] evaluated the efficacy of various organic insecticides against aphids in *Bt* cotton. These insecticides included spinosad 48 SC (75 g ai/ha), vertimec 1.9 EC (45 g ai/ha), *Verticillium lecanii*, *Beauveria bassiana*, *Dashparni* extract (2 L/ha), and neem oil (1 L/ha). Pooled results across the study revealed that spinosad 48 SC and vertimec 1.9 EC were the most effective treatments, with the lowest average aphid population of 8.65 and 10.35 aphids per three leaves, respectively. Neem oil followed with an average of 13.73 aphids per three leaves. The remaining treatments showed

decreasing effectiveness in the following order: *Metarhizium anisopliae* (16.94 aphids/3 leaves), *Verticillium lecanii* (17.66 aphids/3 leaves), *Dashparni* extract (17.98 aphids/3 leaves), and *Beauveria bassiana* (18.89 aphids/3 leaves). Gaikwad *et al.* (2020) [2] carried out an experiment including both the chemicals, botonicals and biorational-insecticides has been conducted to evaluate their efficacy against aphid on okra. The results revealed that during both the years, most superior treatment for management of aphid on okra was thiamethoxam 25 WG followed by emamectin benzoate 5 SG, NSKE 5%, neem oil 0.2%, *Dashparni* ark 0.6%, *Verticillium lecanii* 0.4% and *Metarhizium+ Beauveria bassiana* 0.4%. *Beauveria bassiana* 0.4%, Biomix 0.3%, Karanj oil 0.5% and Eucalyptus oil 0.2% which was statistically at par with each other. The highest aphid population was noticed in untreated plot.

The findings of above researchers suggest that the botanicals individually or in combination were effective for management of aphids on different crops as compared to untreated control.

Overall, the results suggest that fermented Dashparni extract, particularly the 45-day fermented version, holds promise as a natural pest control agent for cotton crops. It could serve as a valuable alternative to synthetic pesticides, potentially reducing environmental impact and promoting sustainable agricultural practices.

Table 2: Effect of aqueous and ethanolic extracts from *Dashparni* leaves against aphids on *Bt* cotton after first spraying during *Kharif* 2023

Tr. No.	Treatments	No. of aphids/3 leaves						Reduction over control (%)
		First Spraying						
		Precount	1 DAS	3 DAS	7 DAS	14 DAS	Mean	
T_1	Fresh *Dashparni* extract	25.67 (5.09)*	21.77 (4.72)	16.60 (4.13)	21.03 (4.64)	26.60 (5.20)	21.50	18.92
T_2	Decoction *Dashparni* extract	26.00 (5.13)	22.30 (4.77)	17.80 (4.27)	24.50 (4.99)	27.90 (5.30)	23.13	12.78
T_3	Ethyl acetate *Dashparni* extract	26.20 (5.16)	20.10 (4.50)	15.20 (3.96)	17.15 (4.17)	22.67 (4.81)	18.78	29.18
T_4	Petrolium ether *Dashparni* extract	25.90 (5.14)	20.47 (4.58)	16.03 (4.06)	18.63 (4.37)	23.78 (4.92)	19.73	25.60
T_5	Fermented *Dashparni* extract (15 days old)	25.13 (5.05)	19.83 (4.49)	13.20 (3.70)	14.87 (3.91)	20.35 (4.56)	17.06	35.67
T_6	Fermented *Dashparni* extract (30 days old)	25.60 (5.10)	18.97 (4.40)	12.14 (3.55)	14.30 (3.83)	18.90 (4.39)	16.08	39.36
T_7	Fermented *Dashparni* extract (45 days old)	25.40 (5.08)	17.06 (4.18)	11.80 (3.50)	13.75 (3.77)	18.43 (4.34)	15.26	42.45
T_8	Control (Water spray)	25.43 (5.09)	24.90 (5.03)	25.23 (5.07)	27.74 (5.31)	28.20 (5.35)	26.52	
	SE ±	0.23	0.24	0.18	0.20	0.22		
	CD at 5%	0.71	0.73	0.55	0.62	0.67		
	CV (%)	8.12	9.31	8.08	8.29	8.11		

* Figures in parentheses are Square root transformed values.

Table 3: Effect of aqueous and ethanolic extracts from *Dashparni* leaves against aphids on *Bt* cotton after second spraying during *Kharif* 2023

Tr. No.	Treatments	No. of aphids/3 leaves						Reduction over control (%)
		Second Spraying						
		Precount	1 DAS	3 DAS	7 DAS	14 DAS	Mean	
T_1	Fresh *Dashparni* extract	14.20 (3.81)*	11.90 (3.50)	10.30 (3.28)	8.33 (2.95)	13.70 (3.76)	11.06	24.45
T_2	Decoction *Dashparni* extract	14.50 (3.86)	12.25 (3.56)	11.05 (3.38)	8.50 (2.99)	14.50 (3.86)	11.58	20.90
T_3	Ethyl acetate *Dashparni* extract	12.10 (3.54)	10.30 (3.27)	8.10 (2.93)	6.87 (2.71)	11.90 (3.52)	9.29	36.54
T_4	Petrolium ether *Dashparni* extract	12.80 (3.64)	10.60 (3.31)	8.50 (2.99)	7.10 (2.73)	12.23 (3.56)	9.61	34.35
T_5	Fermented *Dashparni* extract (15 days old)	11.50 (3.44)	9.45 (3.15)	7.40 (2.80)	6.20 (2.58)	11.20 (3.41)	8.56	41.53
T_6	Fermented *Dashparni* extract (30 days old)	11.33 (3.44)	8.90 (3.05)	7.03 (2.73)	5.97 (2.53)	9.83 (3.21)	7.93	45.83
T_7	Fermented *Dashparni* extract (45 days old)	11.30 (3.43)	8.77 (3.04)	6.30 (2.59)	5.60 (2.47)	8.90 (3.06)	7.39	49.52
T_8	Control (Water spray)	14.70 (3.89)	13.50 (3.73)	15.80 (4.01)	12.45 (3.59)	16.80 (4.15)	14.64	
	SE ±	0.18	0.14	0.19	0.15	0.16		
	CD at 5%	0.53	0.41	0.56	0.45	0.47		
	CV (%)	8.65	7.33	10.67	9.49	7.80		

* Figures in parentheses are Square root transformed values.

Table 4: Effect of aqueous and ethanolic extracts from *Dashparni* leaves against aphids on *Bt* cotton after third spraying during *Kharif* 2023

Tr. No.	Treatments	No. of aphids/3 leaves						Reduction over control (%)
		Third Spraying						
		Precount	1 DAS	3 DAS	7 DAS	14 DAS	Mean	
T_1	Fresh *Dashparni* extract	16.77 (4.15)*	13.20 (3.70)	10.23 (3.27)	14.50 (3.86)	17.33 (4.21)	13.82	29.34
T_2	Decoction *Dashparni* extract	18.60 (4.37)	13.67 (3.76)	10.70 (3.34)	15.33 (3.97)	18.20 (4.31)	14.48	25.97
T_3	Ethyl acetate *Dashparni* extract	15.33 (3.97)	12.10 (3.54)	9.50 (3.16)	12.70 (3.63)	14.58 (3.87)	12.22	37.52
T_4	Petrolium ether *Dashparni* extract	16.20 (4.08)	12.67 (3.61)	9.87 (3.21)	13.30 (3.71)	16.35 (4.09)	13.05	33.28
T_5	Fermented *Dashparni* extract (15 days old)	14.60 (3.88)	10.90 (3.37)	8.20 (2.94)	9.77 (3.19)	11.80 (3.50)	10.17	48.01
T_6	Fermented *Dashparni* extract (30 days old)	14.20 (3.83)	10.05 (3.24)	7.45 (2.81)	8.90 (3.06)	11.33 (3.43)	9.43	51.78
T_7	Fermented *Dashparni* extract (45 days old)	13.30 (3.70)	9.70 (3.19)	7.00 (2.73)	8.50 (3.00)	10.50 (3.30)	8.93	54.34
T_8	Control (Water spray)	20.13 (4.52)	18.36 (4.33)	17.90 (4.28)	20.50 (4.58)	21.49 (4.68)	19.56	
	SE ±	0.18	0.15	0.17	0.17	0.17		
	CD at 5%	0.54	0.45	0.50	0.50	0.52		
	CV (%)	7.88	7.38	9.20	8.18	7.77		

* Figures in parentheses are Square root transformed values.

Conclusion

The study demonstrated that fermented Dashparni extract, especially the 45-day fermented version, was the most effective treatment for reducing aphid populations on cotton crops. The fermentation process significantly enhanced the extract's pesticidal properties, with longer fermentation periods yielding better results. Among the solvents used, ethyl acetate and petroleum ether extracts showed moderate effectiveness, while fresh and decoction extracts were less efficient. Decoction, in particular, was the least effective, likely due to the degradation of active compounds during boiling. These findings suggest that fermented Dashparni extract can be a sustainable and eco-friendly alternative to synthetic pesticides, offering a promising approach to integrated pest management in cotton farming.

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