P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating (2025): 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; SP-Issue 10; October 2025; Page No. 26-30

Received: 11-08-2025
Accepted: 13-09-2025

Indexed Journal
Peer Reviewed Journal

Assessment of knowledge and adoption of pest management practices under the Crop Pest Surveillance and Advisory Project (CROPSAP) among cotton growers

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DOI: https://doi.org/10.33545/26180723.2025.v8.i10Sa.2553

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Abstract

The present study entitled "Assessment of Knowledge and Adoption of Pest Management Practices under the Crop Pest Surveillance and Advisory Project (CROPSAP) among Cotton Growers" was conducted to assess the impact of CROPSAP interventions on the knowledge and adoption levels of beneficiary and non-beneficiary cotton growers. The project aims to strengthen pest surveillance and promote the adoption of scientific pest management practices among farmers through timely advisories and field demonstrations. The present study was conducted in Kandhar, Loha and Ardhapur tehsils which were purposively selected from Nanded district of Marathwada region of Maharashtra State. A comparative analysis was carried out between 75 beneficiary and 75 non-beneficiary cotton growers selected through a random sampling method from the study area. The findings revealed that a majority of the beneficiary farmers possessed a higher level of knowledge and adoption compared to their non-beneficiary counterparts. All beneficiaries (100%) knew about removing pink bollworm-infested rosette flowers, whereas only 86.67% of non-beneficiaries were aware. Knowledge of using *Trichogrammatoidea bactrae* (Trichocards) was 72.00% for beneficiaries and 41.33% for non-beneficiaries, while awareness of pheromone trap installation was 93.33% and 72.00%, respectively. Awareness of the first spray schedule (NSKE 5% or Azadirachtin) was 92.00% among beneficiaries versus 78.67% non-beneficiaries; second spray knowledge was 77.33% and 60.00%; third spray knowledge was 70.67% and 44.00%; and fourth spray knowledge was 74.67% and 49.33%. Beneficiaries (53.33%) were also more aware than non-beneficiaries (36.00%) about avoiding early pyrethroid sprays to prevent whitefly outbreaks. Knowledge about conserving beneficial insects was 86.67% for beneficiaries and 64.00% for non-beneficiaries; Verticillium lecanii usage was 78.67% and 57.33%; NSKE or Azadirachtin for sucking pests, 92.00% and 70.67%; sticky traps, 90.67% and 65.33%; recommended insecticides for sucking pests, 81.33% and 60.00%; Acephate or Chlorpyrifos for mealy bugs, 88.00% and 70.67%; and mite management, 89.33% and 61.33%, respectively.

Adoption of recommended practices followed a similar trend. Removing infested flowers was adopted by 100% of beneficiaries and 82.67% of non-beneficiaries; Trichocards, 62.67% and 36.00%; pheromone traps, 86.67% and 65.33%; first spray, 84.00% and 72.00%; second spray, 73.33% and 57.33%; third spray, 66.67% and 44.00%; fourth spray, 70.67% and 46.67%; avoiding early pyrethroids, 50.67% and 36.00%; conservation of beneficial insects, 77.33% and 60.00%; Verticillium lecanii, 68.00% and 49.33%; NSKE or Azadirachtin for sucking pests, 80.00% and 57.33%; sticky traps, 78.67% and 60.00%; recommended insecticides, 74.67% and 56.00%; Acephate or Chlorpyrifos, 72.00% and 62.67%; and mite management, 76.00% and 53.33%, respectively.

These results indicate that CROPSAP significantly enhanced both knowledge and field-level adoption of integrated pest management (IPM) practices among beneficiaries, demonstrating the effectiveness of regular advisories, training, and field demonstrations in promoting sustainable cotton pest management.

Keywords: CROPSAP, cotton growers, knowledge, adoption, beneficiaries, non-beneficiaries

1. Introduction

In Maharashtra, the major Kharif crops are soybean, cotton, rice, tur, sorghum, and bajra, while sorghum, wheat, and gram are commonly grown in the Rabi season. In recent years, farmers have increasingly shifted to cotton and soybean cultivation due to their higher yield per hectare and better market prices. Pest and disease management is a critical aspect of crop production, as these can cause yield losses of 20–30%. Changes in rainfall patterns and weather conditions often create favorable conditions for pest and disease outbreaks, which can result in substantial economic losses if not managed promptly. During September–October 2008, soybean crops in the Marathwada and Vidarbha regions experienced a sudden outbreak of defoliators. The

pest spread very quickly, affecting nearly 48% of the sown area, with more than 50% crop loss reported in 70% of the infested fields. Since the agricultural economy in these regions relies heavily on cotton and soybean, farmers faced serious financial difficulties. To prevent such losses and develop a long-term strategy for pest management, the Department of Agriculture launched the "Awareness-cum-Surveillance Programme for Management of Major Pests in Cotton-Soybean Based Cropping System in Maharashtra" in 2009–10, under the guidance of the National Centre for Integrated Pest Management (NCIPM), New Delhi. This initiative continued from 2010–11 as the "Crop Pest Surveillance and Advisory Project" (CROPSAP).

Initially, the project focused on soybean and cotton and was carried out in collaboration with various central research institutes and state agricultural universities, such as the Indian Institute of Soybean Research, Indore; Central Institute of Cotton Research, Nagpur; Central Research Institute for Dryland Agriculture, Hyderabad; Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola; and Mahatma Phule Krishi Vidyapeeth, Rahuri. Later, the project was expanded to include tur, gram, and rice with the participation of Indian Institute of Pulses Research, Kanpur; Directorate of Rice Research, Hyderabad; National Rice Research Institute, Cuttack; Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli; and National Institute of Plant Health Management, Hyderabad. The program was initially implemented through the Rashtriya Krishi Vikas Yojana (RKVY) and, due to its significance, was included in the regular state plan scheme from 2013–14.

Source: (https://cropsap.maharashtra.gov.in/)

The findings of this study are expected to assess the impact of CROPSAP interventions on the knowledge and adoption levels of beneficiary and non-beneficiary cotton growers. The project aims to strengthen pest surveillance and promote the adoption of scientific pest management practices among farmers through timely advisories and field demonstrations. Keeping this in view, the present study was conducted with the following specific objectives.

1. To assess the level of knowledge of beneficiary and non-beneficiary cotton growers regarding pest management practices recommended under the Crop Pest Surveillance and Advisory Project.
2. To analyze the extent of adoption of Crop Pest Surveillance and Advisory Project recommended pest management practices among beneficiary and non-beneficiary cotton growers.

2. Materials and Methods

The study was carried out in Nanded district of the Marathwada region of Maharashtra. For representative sampling, three tehsils Kandhar, Loha and Ardhapur were selected based on the implementation of the Crop Pest Surveillance and Advisory Project (CROPSAP) and the presence of a significant number of beneficiary cotton growers. From these tehsils, fifteen villages (five from each tehsil) with a considerable number of CROPSAP beneficiary farmers were chosen. In each selected village, five beneficiary and five non-beneficiary cotton growers were included in the study. Overall, the sample consisted of 75 beneficiary and 75 non-beneficiary cotton growers, making a total of 150 respondents.

3. Results and Discussion

3.1. Knowledge

Table 1: Distribution of beneficiary and non-beneficiary cotton growers according to their advisory wise knowledge about Crop Pest Surveillance and Advisory Project for pest and its control measures of cotton crop

Sr. No.	Statements	Knowledge			
		Beneficiaries (N=75)		Non-beneficiaries (N=75)	
		Yes	No	Yes	No
1.	Pink bollworm infested rosette flowers are found, remove them along with larvae	75 (100)	00 (00.00)	65 (86.67)	10 (13.33)
2.	Place 5-6 Trichocards of *Trichogrammatoidea bactrae* per hectare on the cotton crop during the flowering and boll stage	54 (72.00)	21 (28.00)	31 (41.33)	44 (58.67)
3.	For the management of pink bollworm, install 5 pheromone traps per hectare for monitoring and 25 pheromone traps per hectare for mass trapping	70 (93.33)	05 (06.67)	54 (72.00)	21 (28.00)
4.	For the management of pink bollworm I) Spray NSKE 5% or Azadiractin 1500 ppm @2.5ml or 10000 ppm @1 ml per litre	69 (92.00)	06 (08.00)	59 (78.67)	16 (21.33)
	II) Second spraying with Profenophos 50% EC @30 ml or Quinalphos 20% AF @25 ml or Chlorpyrifos 20% EC @25 ml or Thiodicarb 75 WP @20 gm or Indoxacarb 14.5% + Acetamiprid 7.7% SC @8 ml per 10 litre of water	58 (77.33)	17 (22.67)	45 (60.00)	30 (40.00)
	III) Third spraying with Thiamethoxam 12.6 + Lambda-Cyhalothrin 9.5 ZC in @4ml or Chlorantraniliprole 9.3% + Lambda Cyhalothrin 4.6% @5ml or Emamectin benzoate 5% SG @4 gm or Chlorantraniliprole 18.5% SC @3ml per 10 litre of water	53 (70.67)	22 (29.33)	33 (44.00)	42 (56.00)
	IV) Fourth spraying with Pyriproxyfen 5% + Fenpropathrin 15% EC @10 ml or Lambda Cyhalothrin 25% EC @7.5 ml or Cypermethrin 25% EC @4ml or Profenophos 40%+ Cypermethrin 4% EC @20ml per 10 litre of water	56 (74.67)	19 (25.33)	37 (49.33)	38 (50.67)
5.	Avoid spraying of pyrethroid insecticides before November month, as it may lead to an outbreak of whiteflies	40 (53.33)	35 (46.67)	27 (36.00)	48 (64.00)
6.	Conserve Beneficial insects, if adults and larvae of predators of sucking pest like Lady bird beetle and Chrysopa are spotted, Protect them and avoid insecticide spraying.	65 (86.67)	10 (13.33)	48 (64.00)	27 (36.00)
7.	Spray Verticillium lecanii 1.15% WP @40 gm/ 10 litre of water for the management of Mealy bugs and @50 gm/10 litre of water for Whiteflies	59 (78.67)	16 (21.33)	43 (57.33)	32 (42.67)

8.	Spray 5% NSKE or Azadiractin 300 ppm @50 ml/10 litre of water for Sucking pest	69 (92.00)	06 (08.00)	53 (70.67)	22 (29.33)
9.	Install 10-12 yellow or blue sticky traps per hectare for management of sucking pests	68 (90.67)	07 (09.33)	49 (65.33)	26 (34.67)
10.	For cotton sucking pest spray Flonicamid 50% WG @2gm or Thiamethoxam 25% WG @2 gm or Diafenthiuron 50% WP @12 gm or Buprofezin 25% SC @20 ml or Fipronil 5% SC @30 ml or Acephate 50% + Imidacloprid 1.8% SP @20 gm or Fipronil 5% + Buprofezin 20% SC @20 ml or Fipronil 04% + Acetamiprid 04% SC @20 ml or Pyriproxyfen 05% + Difenthiuron 25% SE @20 ml or Clothianidin 3.5% + Pyriproxyfen 8% SE @25 ml or Pyriproxyfen 8% + Dinotefuran 5% + Difenthiuron 18% SC @12 ml or Difenthiuron 30% + Pyriproxyfen 8% SC @20 ml or Dinotefuran 4% + Acephate 50% SG @17.6 gm	61 (81.33)	14 (18.67)	45 (60.00)	30 (40.00)
11.	For Mealy bug spray Acephate 75% SP @20 gm or Chlorpyrifos 20% EC @20 ml or Buprofezin 25% SC @20ml per 10 litre of water	66 (88.00)	09 (12.00)	53 (70.67)	22 (29.33)
12.	For management of Mites spray Dicofol 18.5% EC @54 ml or Spiromesifen 22.9% SC @12 ml per 10 litre of water	67 (89.33)	08 (10.67)	46 (61.33)	29 (38.67)

The findings presented in Table 1 indicate that the knowledge level of beneficiary cotton growers under the Crop Pest Surveillance and Advisory Project (CROPSAP) was significantly higher compared to that of non-beneficiaries across all recommended pest management practices.

It was observed that all beneficiary farmers (100%) had complete knowledge regarding the removal of pink bollworm-infested rosette flowers along with larvae, whereas only 86.67 per cent of non-beneficiaries were aware of this practice. This difference clearly highlights the positive impact of CROPSAP advisories and demonstrations in increasing awareness about cultural pest control methods that help minimize pest spread at an early stage. Knowledge about the use of *Trichogrammatoidea bactrae* (Trichocards) was possessed by 72.00 per cent of beneficiary farmers, while only 41.33 per cent of non-beneficiaries were aware of this eco-friendly biological control practice. Similarly, 93.33 per cent of beneficiaries and 72.00 per cent of non-beneficiaries knew about the installation of pheromone traps for monitoring and mass trapping of pink bollworm. This reflects that the beneficiaries, being directly connected with CROPSAP activities, were better informed about non-chemical pest management tools compared to non-beneficiaries who lacked such direct exposure.

In relation to spray schedules for pink bollworm management, 92.00 per cent of beneficiaries and 78.67 per cent of non-beneficiaries were aware of the first spray recommendation involving NSKE 5% or Azadirachtin-based formulations. Similarly, for the second spray involving insecticides like Profenophos, Quinalphos, and Thiodicarb, 77.33 per cent of beneficiaries were knowledgeable compared to only 60.00 per cent of non-beneficiaries. The third spray, which includes Thiamethoxam + Lambda-Cyhalothrin or Emamectin benzoate formulations, was known to 70.67 per cent of beneficiaries against 44.00 per cent of non-beneficiaries, whereas 74.67 per cent of beneficiaries and 49.33 per cent of non-beneficiaries were aware of the fourth spray recommendations. These results clearly indicate that beneficiaries possessed a more systematic understanding of sequential pest management practices due to the project's continuous training and advisory support. Further, 53.33 per cent of beneficiaries and only 36.00 per cent of non-beneficiaries knew about avoiding pyrethroid sprays before November to prevent whitefly outbreaks. Though the awareness among beneficiaries was moderate, it was notably higher than that of non-beneficiaries, indicating partial success of CROPSAP in disseminating this precautionary measure. Regarding the conservation of beneficial insects, 86.67 per cent of beneficiaries were aware of protecting predators like ladybird beetles and *Chrysopa*, compared to 64.00 per cent of non-beneficiaries. This shows that the project effectively promoted the concept of ecological balance through the protection of natural enemies. Knowledge about using *Verticillium lecanii* for managing mealy bugs and whiteflies was recorded among 78.67 per cent of beneficiaries and 57.33 per cent of non-beneficiaries. Likewise, 92.00 per cent of beneficiaries and 70.67 per cent of non-beneficiaries were aware of using NSKE 5% or Azadirachtin 300 ppm for sucking pests. Awareness about installing yellow or blue sticky traps for sucking pest management was observed among 90.67 per cent of beneficiaries compared to 65.33 per cent of non-beneficiaries. These results signify that CROPSAP interventions substantially improved knowledge related to environmentally safe pest control practices. Further, 81.33 per cent of beneficiaries and 60.00 per cent of non-beneficiaries were knowledgeable about the recommended chemical insecticides for sucking pest management. Similarly, 88.00 per cent of beneficiaries and 70.67 per cent of non-beneficiaries knew about spraying Acephate or Chlorpyrifos for mealy bug control. Knowledge regarding the management of mites using Dicofol or Spiromesifen was found among 89.33 per cent of beneficiaries compared to 61.33 per cent of non-beneficiaries. These findings collectively suggest that CROPSAP successfully enhanced the technical knowledge of beneficiary cotton growers on both biological and chemical pest management measures. The increase in awareness among beneficiaries can be attributed to regular field visits, advisories, and training programs conducted under the project.

3.2. Adoption

Table 2: Distribution of beneficiary and non-beneficiary cotton growers according to their advisory wise adoption about Crop Pest Surveillance and Advisory Project for pest and its control measures of cotton crop

Sr. No.	Statements	Adoption			
		Beneficiaries (N=75)		Non-beneficiaries (N=75)	
		Yes	No	Yes	No
1.	Pink bollworm infested rosette flowers are found, remove them along with larvae	75 (100)	00 (00.00)	62 (82.67)	13 (17.33)
2.	Place 5-6 Trichocards of *Trichogrammatoidea bactrae* per hectare on the cotton crop during the flowering and boll stage	47 (62.67)	28 (37.33)	27 (36.00)	48 (64.00)
3.	For the management of pink bollworm, install 5 pheromone traps per hectare for monitoring and 25 pheromone traps per hectare for mass trapping	65 (86.67)	10 (13.33)	49 (65.33)	26 (34.67)
4.	For the management of pink bollworm I) Spray NSKE 5% or Azadiractin 1500 ppm @2.5ml or 10000 ppm @1 ml per litre	63 (84.00)	12 (16.00)	54 (72.00)	21 (28.00)
	II) Second spraying with Profenophos 50% EC @30 ml or Quinalphos 20% AF @25 ml or Chlorpyrifos 20% EC @25 ml or Thiodicarb 75 WP @20 gm or Indoxacarb 14.5% + Acetamiprid 7.7% SC @8 ml per 10 litre of water	55 (73.33)	20 (26.67)	43 (57.33)	32 (42.67)
	III) Third spraying with Thiamethoxam 12.6 + Lambda-Cyhalothrin 9.5 ZC in @4ml or Chlorantraniliprole 9.3% + Lambda Cyhalothrin 4.6% @5ml or Emamectin benzoate 5% SG @4 gm or Chlorantraniliprole 18.5% SC @3ml per 10 litre of water	50 (66.67)	25 (33.33)	33 (44.00)	42 (56.00)
	IV) Fourth spraying with Pyriproxyfen 5% + Fenpropathrin 15% EC @10 ml or Lambda Cyhalothrin 25% EC @7.5 ml or Cypermethrin 25% EC @4ml or Profenophos 40%+ Cypermethrin 4% EC @20ml per 10 litre of water	53 (70.67)	22 (29.33)	35 (46.67)	40 (53.33)
5.	Avoid spraying of pyrethroid insecticides before November month, as it may lead to an outbreak of whiteflies	38 (50.67)	37 (49.33)	27 (36.00)	48 (64.00)
6.	Conserve Beneficial insects, if adults and larvae of predators of sucking pest like Lady bird beetle and Chrysopa are spotted, Protect them and avoid insecticide spraying.	58 (77.33)	17 (22.67)	45 (60.00)	30 (40.00)
7.	Spray Verticillium lecanii 1.15% WP @40 gm/ 10 litre of water for the management of Mealy bugs and @50 gm/10 litre of water for Whiteflies	51 (68.00)	24 (32.00)	37 (49.33)	38 (50.67)
8.	Spray 5% NSKE or Azadiractin 300 ppm @50 ml/10 litre of water for Sucking pest	60 (80.00)	15 (20.00)	43 (57.33)	32 (42.67)
9.	Install 10-12 yellow or blue sticky traps per hectare for management of sucking pests	59 (78.67)	16 (21.33)	45 (60.00)	30 (40.00)
10.	For cotton sucking pest spray Flonicamid 50% WG @2gm or Thiamethoxam 25% WG @2 gm or Diafenthiuron 50% WP @12 gm or Buprofezin 25% SC @20 ml or Fipronil 5% SC @30 ml or Acephate 50% + Imidacloprid 1.8% SP @20 gm or Fipronil 5% + Buprofezin 20% SC @20 ml or Fipronil 04% + Acetamiprid 04% SC @20 ml or Pyriproxyfen 05% + Difenthiuron 25% SE @20 ml or Clothianidin 3.5% + Pyriproxyfen 8% SE @25 ml or Pyriproxyfen 8% + Dinotefuran 5% + Difenthiuron 18% SC @12 ml or Difenthiuron 30% + Pyriproxyfen 8% SC @20 ml or Dinotefuran 4% + Acephate 50% SG @17.6 gm	56 (74.67)	19 (25.33)	42 (56.00)	33 (44.00)
11.	For Mealy bug spray Acephate 75% SP @20 gm or Chlorpyrifos 20% EC @20 ml or Buprofezin 25% SC @20ml per 10 litre of water	54 (72.00)	21 (28.00)	47 (62.67)	28 (37.33)
12.	For management of Mites spray Dicofol 18.5% EC @54 ml or Spiromesifen 22.9% SC @12 ml per 10 litre of water	57 (76.00)	18 (24.00)	40 (53.33)	35 (46.67)

The results presented in Table 2 revealed that the adoption of recommended pest control practices was considerably higher among the beneficiary cotton growers than the non-beneficiaries, indicating that the increase in knowledge through CROPSAP was effectively translated into field-level action. All the beneficiary farmers (100%) adopted the practice of removing pink bollworm-infested rosette flowers, while 82.67 per cent of non-beneficiaries followed this method. This full adoption among beneficiaries indicates a positive behavioral change resulting from direct exposure to project advisories and field demonstrations.

Adoption of *Trichocards* for biological control of pink bollworm was reported by 62.67 per cent of beneficiaries as compared to 36.00 per cent of non-beneficiaries, while installation of pheromone traps was adopted by 86.67 per cent of beneficiaries and 65.33 per cent of non-beneficiaries. These findings reflect that CROPSAP effectively motivated farmers to apply IPM-based practices in their fields. Regarding the recommended spray schedules, 84.00 per cent of beneficiaries adopted the first spray (NSKE 5% or Azadirachtin-based), whereas only 72.00 per cent of non-beneficiaries did so. Similarly, for the second spray, 73.33 per cent of beneficiaries and 57.33 per cent of non-beneficiaries adopted the recommended insecticides. For the third spray, 66.67 per cent of beneficiaries and 44.00 per cent of non-beneficiaries followed the advisory, while in the case of the fourth spray, 70.67 per cent of beneficiaries and 46.67 per cent of non-beneficiaries adopted it. These findings confirm that CROPSAP advisories helped ensure the timely and correct application of pest management operations among its beneficiaries. The practice of avoiding early pyrethroid sprays before November was followed by 50.67 per cent of beneficiaries and 36.00 per cent of non-beneficiaries. This moderate adoption rate among beneficiaries suggests the need for continued awareness efforts to discourage indiscriminate insecticide use. Conservation of beneficial insects was adopted by 77.33 per cent of beneficiaries and 60.00 per cent of non-beneficiaries, showing that project interventions effectively encouraged sustainable pest control behavior. Use of *Verticillium lecanii*

for mealy bug and whitefly management was reported by 68.00 per cent of beneficiaries as compared to 49.33 per cent of non-beneficiaries, while the use of NSKE 5% or Azadirachtin 300 ppm for sucking pest management was adopted by 80.00 per cent of beneficiaries and 57.33 per cent of non-beneficiaries. Likewise, installation of sticky traps was done by 78.67 per cent of beneficiaries and 60.00 per cent of non-beneficiaries, indicating better awareness and access to eco-friendly pest monitoring tools among beneficiaries. Further, the use of recommended insecticides for sucking pest management was adopted by 74.67 per cent of beneficiaries compared to 56.00 per cent of non-beneficiaries, while the use of Acephate or Chlorpyrifos for mealy bug management was adopted by 72.00 per cent of beneficiaries and 62.67 per cent of non-beneficiaries. In the case of mite management, 76.00 per cent of beneficiaries adopted Dicofol or Spiromesifen sprays, whereas only 53.33 per cent of non-beneficiaries followed the recommended practice.

Overall, the adoption results indicate that the CROPSAP interventions brought about a significant improvement in the adoption behavior of cotton growers. Beneficiary farmers not only possessed higher knowledge but also demonstrated better implementation of integrated pest management (IPM) practices, emphasizing the project's effectiveness in promoting environmentally sustainable and economically viable pest management. These findings are in line with the general understanding that effective extension communication, timely advisories, and practical demonstrations are key drivers for technology adoption among farmers.

4. Conclusion

The study revealed that beneficiary cotton growers under the Crop Pest Surveillance and Advisory Project (CROPSAP) possessed significantly higher levels of knowledge and adoption of recommended pest management practices compared to non-beneficiaries. The project interventions, including timely advisories, field demonstrations, and expert guidance, effectively enhanced farmers awareness and encouraged the practical implementation of integrated pest management (IPM) techniques. The findings clearly indicate that CROPSAP played a vital role in promoting eco-friendly and sustainable pest control methods, reducing indiscriminate pesticide use, and strengthening scientific pest surveillance among cotton growers.

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