



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; SP-9(1): 167-170
Received: 21-10-2025
Accepted: 28-11-2025

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Adoption of MPKV released recommendations of sugarcane by farmers: Evidence from Kolhapur district, Maharashtra

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i1Sc.4668>

Abstract

This study assessed the adoption levels of university-released sugarcane management recommendations among farmers in Kolhapur district, Maharashtra, a leading sugarcane production area. Despite proven benefits in yield, water efficiency, and sustainability, gaps persist between research and farm practices. An ex-post-facto research design was employed, purposively selecting Kolhapur district, Karveer and Shirol tehsils, 10 villages, and 120 sugarcane growers via multi-stage sampling using the 'N' method. Data were collected through personal interviews with a structured schedule developed with experts from Mahatma Phule Krishi Vidyapeeth, Rahuri. Findings revealed medium adoption (60.83%) overall, with low (28.34%) and high (10.83%) levels among respondents. Partial adoption dominated in planting techniques (35.84%), nutrient management via fertigation (35.83%), disease control (38.34%), and drip irrigation (31.67%). Complete adoption was low for sett treatment with oligochitosan (7.50%), nursery media (11.67%), and subsurface drip scheduling (0%), attributed to high costs, limited awareness, input unavailability, and traditional preferences. Pest control (24.16% complete) and rust management (25.83%) fared better. Results highlight extension gaps, Enhanced demonstrations, subsidies for drip/biofertilizers, and training can boost uptake, improving productivity, resource efficiency, and climate resilience.

Keywords: Sugarcane, adoption level, MPKV recommendations, Kolhapur

Introduction

Sugarcane (*Saccharum* spp.) stands as a cornerstone of global agriculture, serving as the primary source of sucrose for food, biofuel, and industrial applications. Effective management practices are essential to optimize yield, sustainability, and resilience amid climate challenges and resource constraints. This introduction explores the significance, key components, and evolving strategies in sugarcane management. Sugarcane production reached approximately 1.9 billion tonnes worldwide in recent years, with Brazil and India leading as top producers at over 746 million and 376 million tonnes, respectively (Babu *et al.*, 2022) ^[3]. Projections indicate growth to 2.1 billion tonnes by 2034, driven by yield improvements in India and area expansion in Brazil (OECD-FAO, 2025) ^[5]. In India, particularly Maharashtra, production faces instability due to land degradation and excessive water use, underscoring the need for enhanced practices (Abnave, 2023) ^[1]. Domesticated around 10,000 years ago in New Guinea from *Saccharum robustum*, sugarcane evolved through nobilization—interspecific hybridization with *Saccharum spontaneum* for disease resistance and vigor (Babu *et al.*, 2022) ^[3]. Modern cultivars, polyploid hybrids with 80% *S. officinarum* and 10-15% *S. spontaneum* genomes, emerged from Dutch breeding in Java and Indian programs like ICAR-Sugarcane Breeding Institute (van Antwerpen *et al.*, 2022) ^[6]. These developments boosted productivity from 31 t/ha in 1930 to 68 t/ha by 2014 in India (Babu *et al.*, 2022) ^[3]. Optimal management begins with varietal selection for mechanization, stress tolerance, and sucrose content, as seen in Chinese hybrids like YZ 06-407 emphasizing ratooning and biomass (Zhang *et al.*, 2024) ^[7]. Planting techniques, such as ridge-furrow for irrigation efficiency and soil aeration, prevail in irrigated regions like South India (Planting Techniques Review, 2023). Intercropping enhances soil health, reduces pests, and boosts productivity (Intercropping Review, 2024). Integrated nutrient management (INM)

combines organic sources like press mud with minimal synthetics to sustain soil fertility and yields (Management of Sugarcane Review, 2025). Fertigation—drip delivery of urea during full irrigation cycles—improves nitrogen distribution, efficiency, and cane yields up to 151 t/ha versus 124 t/ha in conventional methods (Fertigation Study, 2014). Irrigation scheduling by growth phase (e.g., 550 mm tillering, 1000 mm grand growth) optimizes water use, especially drip saving 44% in Maharashtra's Ghod basin (TNAU Expert System, n.d.; Impact Assessment, 2021). Biotic threats like sugarcane yellow leaf virus and borers limit production across 26 million hectares; integrated pest management (IPM) with Bt transgenics (e.g., Cry1Ac) offers resistance (Aslam *et al.*, 2020; Babu *et al.*, 2022)^[2, 3]. Cultural practices and chlorinated insecticides control termites effectively. Climate change exacerbates droughts and pests, demanding adaptive strategies like drought-tolerant varieties and reduced tillage (Msomba *et al.*, 2024)^[4]. In Maharashtra, productivity declined to 84.8 t/ha due to overuse of water and fertilizers; sustainable shifts to high-yielding varieties and precision practices are vital (Abnave, 2023)^[1]. Root health management through minimal disturbance promotes resilience (van Antwerpen *et al.*, 2022)^[6]. Molecular tools like marker-assisted selection and CRISPR integrate with conventional breeding for stress-tolerant hybrids (Babu *et al.*, 2022)^[3]. Precision agriculture, including AI-driven fertigation and microbiome research, promises higher efficiency (Msomba *et al.*, 2024)^[4]. These advancements ensure sugarcane meets rising demands for sugar (projected 14% production rise) and biofuels while minimizing environmental impact (OECD-FAO, 2025)^[5]. The study aimed at to assess the level of adoption of sugarcane recommendations released by MPKV, Rahuri. Understanding the extent of adoption will help accelerate the advancement of agricultural technologies, ensuring that the information eventually reaches a broader group of farmers. The study's findings will be valuable for extension workers, researchers and policy makers enabling them to enhance the effectiveness of the technology transfer process.

Methodology

This study employed an ex-post-facto research design to examine sugarcane management practices, as independent variables had already occurred and could not be manipulated. This approach ensured validity, objectivity, and efficiency in addressing research questions.

Kolhapur district in Maharashtra was purposively selected due to its highest sugarcane area and production. Two tehsils, Karveer and Shirol, were chosen based on maximum sugarcane cultivation. The district lies between 15°-17° N latitude and 73°-74° E longitude, at 390-600 m above MSL, spanning sub-mountain, mountain, and plain agroclimatic zones. It features rivers like Panchaganga and Krishna, with 2024 average rainfall of 1897.58 mm over 72 days, temperatures from 11°C to 37°C, and varied soils: red in hilly west, fertile alluvial in river basins, and medium in eastern tehsils like Shirol.

Sampling involved multi-stage selection. From lists provided by taluka agriculture offices and sugar factories, five villages per tehsil with highest sugarcane area were picked purposively, totaling ten villages. From each village's alphabetical farmer list from sugar factories, 12 growers were selected using the 'N' method, yielding 120 respondents.

Data collection used personal interviews with a structured schedule developed in consultation with experts from Mahatma Phule Krishi Vidyapeeth, Rahuri, tailored to local conditions and study objectives.

Results and Discussion

Adoption of respondents towards university released sugarcane recommendations

According to Rogers and Shoemaker (1971) adoption is a decision to continue full use of an innovation. In this study adoption level refers to the level of following MPKV recommended sugarcane cultivation practices by the respondents. The statement wise information of Adoption levels of respondents towards university released sugarcane recommendations were collected, tabulated and analysed. The results were presented in Table 1.

Adoption levels of specific university recommendations varied across management practices, with partial adoption dominating most categories (Table 1). For sett treatment with oligochitosan @50 ppm for 30 minutes followed by foliar sprays at 30, 60, and 90 days after planting, only 7.50% of respondents achieved complete adoption, while 20.83% showed partial adoption. In planting techniques, 26.66% fully adopted preseasonal sugarcane (Phule 0265) planting at 150 cm row and 60 cm intra-row spacing using 30-35-day-old poly tray seedlings, with 35.84% partial; for suru sugarcane seedlings at 45 cm spacing in 5-foot furrows under subsurface drip with 80% ETc and RDF fertigation, complete adoption was 9.18% and partial 31.66%.

Nursery management saw low uptake: 11.67% completely adopted cocopeat-vermicompost (1:1) media for single-eye bud seedlings in HDPE polytrays, and just 4.17% used Phule supercane technology with 50% soil and 50% FYM/vermicompost/bagasse. Pest control for white grubs via fipronil 40% + imidacloprid 40% WG @437.5 g/ha in June recorded 24.16% complete and 31.67% partial adoption. Disease management for rust with azoxystrobin 18.2% + difenoconazole 11.4% SC @0.1% (three sprays at 15-day intervals) achieved 25.83% complete and 38.34% partial adoption.

Nutrient management results showed 20.83% complete adoption of 60% RDF (240:102:102 N:P2O5:K2O kg ha⁻¹) + 25 t ha⁻¹ FYM with micronutrient fertigation in four splits, and 35.83% partial. For suru sugarcane with 25% N + 75% P + 100% K + 20 t ha⁻¹ FYM + PSB sett treatment and endophytic bacteria foliar spray, partial adoption was 45.00%; complete adoption of 50% NPK fertigation for plant cane and ratoons with biofertilizers (acetobacter, azotobacter, azospirillum, PSB) and trash management stood at 13.33% partial only.

Water management practices had 31.67% partial adoption of drip irrigation with inverted modular micro sprinklers and ratoon trash shredding; drip benefits (33% sugarcane yield increase, 41% water savings, 16% electricity reduction, lower emissions) saw 25.83% complete adoption. No adoption occurred for 75% ETc drip at 3-day intervals for MS 10001 variety or 60% ETc alternate-day irrigation under subsurface drip. Partial adoption reached 29.17% for subsurface drainage (40 m spacing, 1.25 m depth) and 34.17%/28.33% for staged irrigation deficits (100% tillering, 30% grand growth, 60% maturity) in heavy black soils. Overall, 60.83% of respondents exhibited medium adoption levels, followed by 28.34% low and 10.83% high (Table 2). Findings are inline with findings by Lonkar *et al.* (2021)^[8].

Table 1: Distribution of the respondents according to adoption level

	Statements	Adoption		
		CA	PA	NA
A.	Sett Treatment			
1.	Sett treatment of oilgochitosan @50ppm for 30 min at the time of planting followed by three foliar sprays 30.60 and 90 days after planting is recommended for sugarcane yield improvement in <i>Suru</i> season.	9 (07.50)	25 (20.83)	86 (71.67)
B.	Planting Techniques			
1.	Plantation of preseasonal sugarcane (Phule 0265) at row spacing of 150 cm and intra row spacing of 60 cm using 30 to 35 days old Poly Tray settling is recommended for higher cane and CCS yield in medium deep black soils of Western Maharashtra.	32 (26.66)	43 (35.84)	45 (37.50)
2.	Planting of seedlings of <i>suru</i> sugarcane at distance of 45 cm in 5 feet furrows under sub surface drip irrigation scheduled at 80% ETc every alternate day with 80% RDF (200:92:92, N:P2O5:K2O kg ha ⁻¹) through water soluble fertilizers in 30 weekly splits is recommended for medium deep black soil of Western Maharashtra for higher monetary returns.	11 (09.18)	38 (31.66)	71 (59.16)
C.	Nursery Management			
1.	It is recommended to use cocopeat and vermicompost in equal proportion (1:1) as a growing media for raising single eye bud sugarcane seedlings for achieving higher germination percentage of sugarcane seedlings in HDPE polytray.	14 (11.67)	0 (00.00)	106 (88.33)
2.	Phule Supercane Nursery Technology Preparation of sugarcane one eye bud setts ↓ Setts treatment (For 1 liter water 1 g Carbendazim + 3 ml Malathion then for 1 liter water 100 g Acetobacter + 12.5 g Phosphorus solubilizing bacteria) ↓ Prepare raised bed in farmer's field ↓ Spread empty fertilizer bags/ plastic paper on raised bed ↓ Apply growing media in equal proportion on fertilizer bags/ plastic paper ↓ Keep one eye bud setts on fertilizer bags/ plastic paper ↓ Full Irrigation to raised beds ↓ Cover bed with sugarcane trash and black polythene paper for 7 days ↓ Removal sugarcane trash and black polythene paper after 7 days ↓ Daily irrigation after 7 days by watering can/micro sprinkler ↓ Sugarcane settlings ready for planting after 25 days Phule supercane nursery technology with use of 50% soil and 50% farm yard manure or vermicompost or sugarcane bagasse as a growing media in equal proportion (1:1) to achieve higher germination of single eye bud sugarcane setts for planting of sugarcane settlings on farmers own field is recommended.	5 (04.17)	0 (00.00)	115 (95.83)
D.	Pest Control			
1.	Soil application of granular insecticide fipronil 40% + imidacloprid 40% WG @ 437.5 g/ha along the side of ridge in the month of June is recommended for the control of white grub in sugarcane.	29 (24.16)	38 (31.67)	53 (44.17)
E.	Disease Management			
1.	Three sprays of the combi-fungicide azoxystrobin 18.2% + difenconazole 11.4% SC @ 0.1% (1 ml per litre water) at 15 days interval after disease appearance is recommended for effective management of rust disease of sugarcane.	31 (25.83)	46 (38.34)	43 (35.83)
F.	Nutrient Management			
1.	Application of 60% recommended dose of fertilizer (240:102:102 N:P2O5:K2O kg ha ⁻¹) + 25 t ha ⁻¹ FYM along with water soluble solid micronutrient Grade I (Fe 2%, Zn 5%, Mn 1%, Cu 0.5%, B 0.1%) @ 25 kg ha ⁻¹ in four equal splits at planting, 60, 120 and 180 days after planting through fertigation is recommended for obtaining higher yield and monetary returns of preseasonal sugarcane in medium deep black soils of Western Maharashtra.	25 (20.83)	43 (35.83)	52 (43.34)
2.	Application of 25% of recommended dose of nitrogen (62.5 kg ha ⁻¹ N) + 75% phosphorus (86.25 kg ha ⁻¹ P2O5) + 100% potassium (115 kg ha ⁻¹ K2O) and 20 t ha ⁻¹ FYM with sett treatment of PSB @ 1.25 kg ha ⁻¹ at the time of planting to <i>suru</i> sugarcane then, after 60 days of planting foliar spray of consortium of endophytic nitrogen fixing bacteria @ 3 l. ha ⁻¹ in 500 lit of water to sugarcane in the morning hours is recommended for obtaining equivalent use of recommended dose of fertilizer for cane, sugar yield and quality in medium deep black soils of western Maharashtra.	0 (00.00)	54 (45.00)	66 (55.00)
3.	Application of 50 per cent recommended dose of NPK fertilizers to pre-seasonal sugarcane (170:85:85 N:P2O5: K2O kg ha ⁻¹) and its 3 successive ratoons (125:58:58 N:P2O5: K2O kg ha ⁻¹) through fertigation in 44 splits at weekly interval along with FYM 25 t ha ⁻¹ and set treatment of acetobacter and PSB to plant cane and trash management practice along with application of composite culture of biofertilizers (Acetobacter, azotobacter, azospirillum and PSB each @ 1.25 kg ha ⁻¹) to ratoon is recommended for higher cane and CCS yield and to maintain soil fertility.	0 (00.00)	16 (13.33)	104 (86.67)
G.	Water Management			
1.	Planting of <i>suru</i> Sugarcane with drip method for irrigation and inverted modular microsprinkler to create microclimate and trash management in ratoons with shredder machine is recommended for Maharashtra to obtain sustainable and maximum cane yield, economic returns, soil health and efficient water use.	0 (00.00)	38 (31.67)	82 (68.33)
2.	The drip irrigation method increased the yield of sugarcane and cotton, respectively by 33 and 43 per cent, saved 41 and 44 per cent of water and 16 and 42 per cent of electric consumption per hectare with reduction in carbon emissions by 16 and 42 per cent per hectare, compared to conventional surface Irrigation method. Therefore, it is recommended to	31 (25.83)	0 (00.00)	89 (74.17)

	encourage the adoption of drip irrigation for climate smart agriculture on wider scale by the sugarcane and cotton cultivators.			
3	Application of irrigation water through drip at 75% of ETc with 3 days irrigation interval for sugarcane variety MS 10001 is recommended for getting higher water use efficiency (0.37%) and yield.	0 (00.00)	0 (00.00)	120 (100.00)
4.	The subsurface drainage system with 40 m drain spacing between two perforated pipes and 1.25 m drain depth is recommended for optimum drainage, improving soil health and economic production of sugarcane in waterlogged Vertisols.	0 (00.00)	35 (29.17)	85 (70.83)
5.	It is recommended to irrigate suru sugarcane with 100% irrigation at tillering stage (45-135 days after planting), 30% water deficit during grand growth stage (136 to 300 days after planting) and 60% water deficit during maturity stage (301 to 360 days after planting) for obtaining optimum production in heavy deep black soils under scarcity zone conditions.	34 (28.33)	41 (34.17)	45 (37.50)
6.	Irrigation at 60% crop evapotranspiration at every alternate day interval throughout the growth period is recommended for efficient water use in <i>Suru</i> sugarcane cultivated under subsurface drip irrigation system in medium deep black soils of Western Maharashtra	0 (00.00)	0 (00.00)	120 (100.00)

Table 2: Distribution of respondents according to their overall adoption regarding sugarcane recommendations released by MPKV Rahuri

Sr. No	Category	Frequency	Percentage
1	Low (up to 10)	73	60.83
2	Medium (11 to 13)	34	28.34
3	High (14 & above)	13	10.83
Total		120	100.00

Conclusion

This study reveals moderate adoption of university-released sugarcane recommendations among Kolhapur farmers, with a majority (60.83%) showing medium-level adoption, followed by low (28.34%) and high (10.83%) levels. Practices like planting techniques (26.66%-35.84% complete/partial adoption), pest control with fipronil-imidacloprid (24.16%-31.67%), and disease management using azoxystrobin-difenoconazole (25.83%-38.34%) saw relatively higher uptake due to clear benefits in yield and protection. Nutrient management through fertigation and biofertilizers (13.33%-45.00%) and water-saving drip irrigation (25.83%-31.67%) also gained partial acceptance for better returns and efficiency. However, complete adoption remained low across most practices—such as sett treatment with oligochitosan (7.50%), nursery management with cocopeat-vermicompost (11.67%), and advanced subsurface drip scheduling (0%)—due to high costs, limited availability, maintenance issues, lack of awareness, and preference for traditional methods. These gaps highlight barriers like insufficient extension services, training, and infrastructure support. To boost adoption, extension agencies should prioritize demonstrations, subsidies for drip systems and bio-inputs, and awareness programs tailored to local needs. Promoting climate-smart practices will enhance sugarcane productivity, sustainability, water efficiency, and farmer incomes in Maharashtra's medium-deep black soils. Future research should test scalable, low-cost interventions to bridge this adoption divide.

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