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Original Article

Seasonal Variation of Arbuscular Mycorrhizal Fungi in Selected Cash Crops During 2023

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Abstract:

The present investigation was conducted to examine the seasonal variation of AMF associated with selected cash crops viz., cotton (Gossypium hirsutum), sugarcane (Saccharum officinarum), and banana (Musa acuminata) during the year 2023. Root samples and rhizosphere soil were collected during monsoon, winter, and summer seasons. Root colonization percentage, type of colonization, spore density, and AM fungal diversity were recorded using standard methods.

The results revealed significant seasonal variations in AMF association among crops. Cotton exhibited maximum root colonization (90.0%) during monsoon and winter seasons. Sugarcane recorded highest colonization (95.0%) and maximum spore density (126 spores/100 g soil) during summer, indicating favorable seasonal conditions for AMF development. Banana showed medium colonization during monsoon (80.0%) but comparatively lower colonization during winter and summer (70.0%). Monsoon season generally supported lower sporulation, while summer season suitable for maximum AMF activity.

The findings suggest that both host crop species and environmental conditions strongly influence AMF colonization and sporulation. Summer season appears most suitable for AMF multiplication and inoculum development in selected cash crops. Utilization of AMF during optimum seasons can improve nutrient management and sustainable crop production.

Keywords: AMF, Seasonal Variation, Cotton, Sugarcane, Banana, Root Colonization, Spore Density, Sustainable Agriculture.

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Introduction:

Arbuscular mycorrhizal fungi (AMF) are obligate symbiotic fungi belonging to the phylum Glomeromycota that colonize roots of nearly 80% of terrestrial plants. They form mutualistic associations in which fungi receive carbohydrates from host plants and in return enhance uptake of phosphorus, nitrogen, zinc, and other essential nutrients (Smith and Read, 2008). AMF also improve water relations, soil aggregation, and plant tolerance against drought, salinity, and soil-borne pathogens.

Cash crops such as cotton, sugarcane, and banana are economically important agricultural products cultivated widely in Maharashtra and other parts of India. These crops require high nutrient inputs for better productivity. Continuous dependence on chemical fertilizers often decreases soil health and microbial diversity. Hence, AMF inoculation has obtained importance as a sustainable biofertilizer technology.

The occurrence and efficiency of AMF are influenced by several environmental factors such as rainfall, soil temperature, moisture content, root growth activity, and cropping practices. Seasonal changes significantly affect spore germination, colonization, and fungal diversity. Understanding seasonal dynamics of AMF in crop rhizosphere is therefore essential for selecting appropriate inoculation periods and improving crop productivity.

The present study was undertaken to examine seasonal variation in AMF associated with cotton, sugarcane, and banana during 2023.

Materials and Methods:

Study Area and Sampling:

Root and rhizosphere soil samples were collected from cultivated fields growing cotton, sugarcane, and banana during monsoon, winter, and summer seasons of 2023. Three biological replicates were maintained for each crop during each season.

Root Colonization:

Collected root samples were washed thoroughly with tap water and cut into 1 cm segments. Roots were cleared and stained using the method of Phillips and Hayman (1970). Percentage root colonization was estimated by the grid-line intersect method of Giovannetti and Mosse (1980).

Spore Isolation and Identification:

AM fungal spores were isolated from 100 g rhizosphere soil by wet sieving and decanting technique (Gerdemann and Nicolson, 1963). Spores were counted under stereomicroscope and identified morphologically using standard taxonomic keys.

Statistical Analysis:

All observations were recorded in triplicates and expressed as mean ± SE. Differences among treatments were tested by Duncan's Multiple Range Test (DMRT) at $p < 0.05$.

Results:

The data presented in Table 1 demonstrated significant seasonal and host-specific variation in arbuscular mycorrhizal fungal (AMF) colonization, colonization pattern, and spore density among the selected cash crops during 2023. Root colonization percentage ranged from 70.0% to 95.0%, indicating differential compatibility of host plants with native AMF populations under varying environmental conditions.

During the monsoon season, maximum root colonization was recorded in *Gossypium hirsutum* (90.0 ± 1.8%), followed by *Musa acuminata* (80.0 ± 1.6%) and *Saccharum officinarum* (75.0 ± 1.5%). Colonization patterns were predominantly hyphal/vesicular (H/V) in cotton, hyphal/arbuscular (H/A) in sugarcane, and only hyphal (H) colonization in banana. Spore density during this season varied from 56 to 73 spores/100 g soil, with maximum sporulation observed in sugarcane.

In the winter season, cotton maintained a high colonization level (90.0 ± 1.8%), whereas sugarcane and banana exhibited 80.0 ± 1.6% and 70.0 ± 1.4% colonization, respectively. Colonization type in cotton shifted to arbuscular/vesicular (A/V), while sugarcane showed H/V colonization and banana exhibited combined A/V/H structures. Spore density increased substantially during winter,

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ranging between 79 and 92 spores/100 g soil, with sugarcane recording the highest sporulation.

During the summer season, *S. officinarum* exhibited the highest root colonization (95.0 ± 1.9%) and maximum spore density (126 spores/100 g soil), indicating highly suitable environmental conditions for AMF development. Cotton showed medium colonization (80.0 ± 1.6%) with 92 spores/100 g soil, while banana recorded comparatively lower colonization (70.0 ± 1.4%) and 73 spores/100 g soil. Hyphal colonization were common in sugarcane, whereas cotton and banana exhibited H/V colonization.

The results indicated that summer season was most conducive for AMF colonization and sporulation, particularly in sugarcane, whereas cotton maintained relatively stable colonization across seasons. Banana Showed comparatively lower AMF association during winter and summer. These findings confirm that seasonal climatic factors and host crop species significantly influence AMF dynamics in agricultural soils.

Tabel: 1. Seasonal variation in AMF associated with selected cash crops during 2023

Seasons	Botanical Name	Root colonization (%)	Type of Colonization	Spore density (No./100 g soil)	AM Fungal Species
Monsoon	*G. hirsutum*	**90.0 ± 1.8 a**	H/V	**68**	*A. elegans, A. delicata, A. spinosa, G. mosseae, G. fasciculatum Scl.Sinuosa*
	S. officinarum	**75.0 ± 1.5 b**	H/A	**73**	*A. delicata, A. spinosa, A. denticulata, G. halan, G. clarum, G. mosseae*
	M. acuminata	**80.0 ± 1.6 b**	H	**56**	*A. thomii, A. elegans, A. laevis, G. clarum, G. fasciculatum GI. decipiens*
Winter	*G. hirsutum*	**90.0 ± 1.8 a**	A/V	**79**	*A. spinosa, A. nicolsonii, A. elegans, A. dilatata, G. mosseae, G. halan, Scu. Scutata*
	S. officinarum	**80.0 ± 1.6 b**	H/V	**92**	*A. laevis, A. nicolsonii, A. dilatata, G. clarum, G. caledonium, G. mosseae*
	M. acuminata	**70.0 ± 1.4 c**	A/V/H	**81**	*A. denticulata, A. thomii, A. nicolsonii, G. clarum, G. fasciculatum, GI. decipiens*
Summer	*G. hirsutum*	**80.0 ± 1.6 b**	H/V	**92**	*A. spinosa, A. thomii, A. nicolsonii, G. clarum, G. caledonium, G. mosseae*
	S. officinarum	**95.0 ± 1.9 a**	H	**126**	*A. tuberculata, A. undulata, A. myriocarpa, A. denticulata, A. delicata, G. fasciculatum, G. rubiforme*
	M. acuminata	**70.0 ± 1.4 c**	H/V	**73**	*A. elegans, A. laevis, A. mellea, G. clarum, G. mosseae, G. caledonium*

Abbreviations: H – Hyphae , V – Vesicular , A- Arbuscules % - Percentage , *G - Gossypium, S- Saccharum , M- Musa, A - Acaulospora , G- Glomus , GI- Gigaspora ,Scl-Sclerocystis , Scu- Scutellospora,* # -Mean of three samples.

All observations were recorded in triplicates and expressed as mean ± SE. Values with different superscript letters (a–e) within a row differ significantly (DMRT, $p < 0.05$).

Discussion:

The results clearly indicate seasonal influence on AMF colonization and sporulation. Cotton showed highest colonization during monsoon and winter (90%), suggesting good compatibility between host roots and native AMF flora. Similar observations were reported by Smith and Read (2008)**,** who stated that host plant species strongly influence the extent of mycorrhizal colonization.

Sugarcane showed best during summer with 95% colonization and maximum spore density (126 spores/100 g soil), indicating favorable soil temperature and active root growth Banana showed medium colonization during monsoon but lower values during winter and summer. Such reduction may be due to host physiological differences, soil moisture stress, or competition among native microbial populations. Brundrett (2009) also reported that AMF development is positively influenced by optimum temperature and active root growth.

Banana showed moderate colonization during monsoon but comparatively lower values in winter and summer. This reduction may be related to host physiological differences, soil moisture stress, or competition with other rhizospheric microorganisms. Similar seasonal fluctuations in banana mycorrhiza were noted by Declerck et al. (2005).

Summer season generally favored sporulation due to dry soil conditions and maturation of fungal propagules. Similar findings were reported by earlier workers, who observed enhanced AMF activity under warm and moderately dry environmental conditions. Seasonal environmental factors therefore function a major role in regulating AMF Changes.

Conclusion:

The present study concludes that AMF colonization and spore density varied significantly among seasons and host crops during 2023. Sugarcane exhibited maximum colonization and sporulation during summer, while cotton maintained consistently high colonization during monsoon and winter. Banana showed comparatively lower AMF association. Summer season was found most favorable for AMF development and inoculum production. Application of AMF during suitable seasons may improve crop nutrition, soil fertility, and sustainable agricultural productivity.

References:

1. Phillips JM, Hayman DS (1970). Improved procedures for clearing roots and staining vesicular-arbuscular mycorrhizal fungi. *Transactions of the British Mycological Society*, 55: 158–161.
2. Brundrett, M. (2009). Mycorrhizal associations and other means of nutrition of vascular plants. *Plant and Soil*, 320: 37–77.
3. Declerck, S., Strullu, D.G. and Fortin, J.A. (2005). *In Vitro Culture of Mycorrhizas*. Springer, Berlin.
4. Giovannetti M, Mosse B (1980). An evaluation of techniques for measuring vesicular-arbuscular mycorrhizal infection in roots. *New Phytologist*, 84: 489–500.
5. Gerdemann JW, Nicolson TH (1963). Spores of mycorrhizal Endogone species extracted from soil by wet sieving and decanting. *Transactions of the British Mycological Society*, 46: 235–244.
6. Smith SE, Read DJ (2008). *Mycorrhizal Symbiosis*. 3rd Edition, Academic Press, London.