Pineapple cultivation in Uttar Pradesh central zone: challenges and opportunities

Abstract

Pineapple cultivation in the central zone of Uttar Pradesh represents a dynamic agricultural endeavor, characterized by both challenges and opportunities. This abstract explores the unique factors that farmers face in this region, shedding light on the potential for this tropical fruit's growth and economic contribution.The central zone of Uttar Pradesh experiences a diverse climate, ranging from hot summers to cold winters. Pineapple, originally a tropical fruit, demands consistent warmth. This climatic variability presents a significant challenge for pineapple growers, who must adapt their cultivation practices to ensure optimal growth and yields. Moreover, the soil quality in this region often falls short of the sandy loam and fertility requirements that pineapple plants thrive in. Soil testing and enhancement become critical tasks for farmers looking to establish a suitable environment for pineapple cultivation.Pests and diseases further compound the challenges. Pineapple plants are susceptible to a range of issues, including mealybugs, aphids, and the dreaded fusarium wilt. Effective pest and disease management strategies are vital to maintaining healthy crop yields while minimizing the use of chemical pesticides. Additionally, many farmers in the central zone may lack the requisite technical knowledge and skills needed for successful pineapple cultivation. Access to training and extension services, as well as modern farming practices, becomes essential to enhance agricultural techniques and overcome these challenges.On the flip side, there are significant opportunities awaiting pineapple growers in this region. Pineapples are increasingly sought after for their unique flavor and nutritional value, creating a robust market demand in both local and national markets. Farmers have the potential to tap into this growing demand and enhance their income through pineapple cultivation.Furthermore, integrating pineapple cultivation into existing cropping systems offers an avenue for crop diversification, reducing dependency on a single crop and enhancing overall farm sustainability. Value addition through processing, such as converting pineapples into juice, jam, or canned fruit, allows farmers to expand their product range, increase shelf life, and reduce post-harvest losses.Government support in the form of initiatives and subsidies designed to promote horticulture and agricultural diversification provides a crucial opportunity for pineapple growers to access financial and technical assistance.

Keywords =central zone, government, potential, crop, Uttar Pradesh

Introduction

Pineapple, the tropical fruit with its sweet and tangy flavor, is a favorite among fruit enthusiasts worldwide. Scientifically known as *Ananas comosus*, this tropical delight is not just appreciated for its exquisite taste but also its versatility. Native to South America and cultivated in tropical and subtropical regions globally, the pineapple is characterized by its spiky, rough exterior and vibrant, juicy flesh inside. Beyond its deliciousness, pineapple is rich in essential nutrients like

vitamin C, manganese, and dietary fiber. Its enzyme bromelain has been studied for its potential health benefits, including aiding digestion and reducing inflammation[20]. The cultivation of pineapples in the central zone of Uttar Pradesh carries significant agricultural and economic importance. This region, primarily known for traditional crops, benefits from pineapple farming in various ways. Pineapple cultivation diversifies the agricultural landscape, offering a valuable alternative to conventional crops. It enhances crop resilience and reduces dependency on a limited set of commodities. Pineapple farming presents an opportunity for income generation for local farmers, contributing to rural economic development. The increasing demand for pineapples, both locally and regionally, creates market opportunities for farmers. This expansion into new markets can potentially boost income and market access for the region. Value addition through processing, such as making pineapple juice and jams, adds an extra dimension to the economic benefits[28, 2].

Climatic and soil conditions of Uttar Pradesh and pineapple

Central Uttar Pradesh experiences a subtropical climate with hot summers and cool winters. Pineapples thrive in warm to tropical conditions. While the summer months can be quite hot, with temperatures exceeding 40°C (104°F), these high temperatures can benefit pineapple growth if other conditions are favorable[5,16,25]. The winter months, with cooler temperatures, can be challenging for pineapples, and protective measures such as mulching may be necessary. The monsoon season begins in July and extends through September. Central Uttar Pradesh receives the majority of its annual rainfall during this period. Winters (December to February) in central Uttar Pradesh are characterized by cool and dry conditions. Daytime temperatures typically range from 12°C to 20°C (54°F to 68°F). Nighttime temperatures can drop considerably, often falling below 5°C (41° F).

Humid tropical climates are good for pineapple growing. As long as the temperature stays moderate, the fruit thrives well both in the interior and close to the coast. 22^0-32^0 C is the ideal temperature needed for optimal growing. A temperature differential of at least 40 degrees Celsius between day and night is ideal for plant growth, while high nighttime temperatures are detrimental to plant growth. If there are no frosts in the area, it can be cultivated up to 1,000 meters above sea level. The required amount of rainfall is between 100 and 150 cm. Plants thrive on soils that are sandy loam and have a pH of 5.0 to 6.0.

Pineapple varieties suitable for Uttar Pradesh central zone

Selecting suitable pineapple varieties for cultivation in the central zone of Uttar Pradesh is crucial for a successful harvest, considering the region's subtropical climate. Queen Victoria (Hybrid Ananas comosus) is one of the most popular pineapple varieties grown in subtropical regions. It is known for its sweet flavor and ability to adapt to varying climates. Queen Victoria pineapples are typically small to medium-sized with golden-yellow flesh and a fragrant aroma. Kew (Hybrid Ananas comosus) have a sweet taste and golden-yellow flesh. These pineapples are known for their juiciness and adaptability to different growing conditions. Mauritius (Hybrid

Ananas comosus) can thrive in subtropical climates, making it a suitable choice for Uttar Pradesh's central zone. Cayenne (Hybrid Ananas comosus can adapt to subtropical conditions and are commonly grown in various parts of India[11,12].

Propagation

One of the three methods for propagation is sucker, slips, or fruit crown. As a sucralose plant, pineapples produce a number of suckers, or plant shoots, during inflorescence. Suckers are cut off from the parent plant and planted to produce new plants when the mature plant begins to wither after fruit harvesting. It takes roughly 22 months from the time suckers are planted to the time the fruits ripen. Many slips are produced by a mature plant at the fruit development stage, and these are taken off the mother plant and sown elsewhere. Within two years, planted slips mature and begin to bear fruit. On well-drained, uniformly moist soil, pineapple fruit crowns with their lower leaves detached are also utilized as planting materials. In two to three weeks, the plant's root system begins to take shape, and it begins to take in nutrients from the soil to keep growing. In two and a half years, the plant reaches maturity and is able to bear its own fruit and flowers.

Planting in pineapple

Raised beds with dimensions of 1 m (width), 3.5 m (length), and 0.4 m (height) were planted with pineapples. Every raised bed was separated by 0.5 meters. On each raised bed, two rows of suckers were positioned at a planting distance of 30 to 60 centimeters[16]

Irrigation management

Fruit increases consistently when irrigations begin no later than three to four weeks before harvest, plants exhibit a minimum of 25% leaf water deficit, and enough water is provided to significantly improve the moisture content of the plant. Drip irrigation is one of the most efficient and commonly used methods for watering pineapples[24]. It delivers water directly to the base of each plant, minimizing water wastage. Pineapples need regular and consistent irrigation, especially during dry spells or periods of low rainfall. Watering should be provided when the soil becomes slightly dry but not waterlogged. Applying organic mulch around the base of pineapple plants helps retain soil moisture and reduce water evaporation. It also aids in weed control and soil temperature regulation. Provide enough water to penetrate the root zone, typically about 8 to 12 inches (20 to 30 centimeters) deep. This encourages deep root development and improves plant stability.

Fertilizer and nutrient management

Pineapples typically require nitrogen (N), phosphorus (P), and potassium (K) as primary nutrients, as well as secondary and micronutrients like magnesium (Mg) and boron (B). The recommended NPK ratio for pineapples is often around 10-10-20, but this can vary based on soil. The CO_2 and N_2O emissions from tropical peat soils grown with pineapple were reduced by

applying pineapple residue ash in combination with NPK fertilizers[16]. When compared to the KCl treatment, the fruits of the K2SO4 treatment were noticeably longer, had thicker skin, had more mass both with and without a crown, and had more eyes. When pineapple plants were fertilized with K2SO4, they yielded noticeably bigger fruits, had noticeably larger crowns, and had more eyes per spiral[19]. More fruitlets per fruit and a higher fruitlet weight contributed to the larger fruit. TSS and ascorbic acid contents were substantially higher in fruit from plants fertilized with KCl than in fruit from plants fertilized with K2SO4[19].

Acclimatization in pineapple

Acclimatization in pineapple cultivation refers to the process of preparing young pineapple plants, typically propagated in a controlled environment like a nursery, for the transition to an outdoor or field environment. This is a crucial step to ensure the successful establishment and growth of pineapple plants in the field.After 30 days of drought, six-month-old pineapple plants that were micro propagated outperformed control plants in terms of CAM[18]. Since they recovered quickly after receiving full water for 15 days, they can be exposed to direct sunlight (high light intensity) for 30 days to help them get used to it. They can then be subjected to a drought for the same period of time to help trigger a defense mechanism against oxidative stress and excessive water loss. In this manner, pineapple plants that have been micro propagated can be hardened to the acclimatization-field transition through drought after being accustomed to direct sunlight[17].

Weed control and mulching

Mulching is a crucial technique in pineapple farming because it helps with temperature control, weed control, and moisture retention, among other things. Select suitable mulch materials, such as organic matter, dried leaves, hay, or straw. To avoid direct contact, spread a layer of mulch around the base of the pineapple plants, making sure to leave space between the mulch and the stem. The "drip line"—the area that the pineapple leaves can reach—should be covered with mulch. This space is critical for both weed control and moisture retention.

Pest and diseases management

Pineapple diseases are associated with microorganisms such as bacteria, viruses, fungi, and pests. They impede a plant's growth both before and after harvesting, damaging and spoiling various plant parts. If the plant is not properly cared for, then the ripe fruit may also become infected with these unwanted members, such as fungi; these are linked to diseases such as Phytophthora root rot (which is caused by the oomycetes Phytophthora nicotine and Phytophthora cinnamomi); Base (butt) rot (which is caused by the fungus Chalaraparadoxa); Fusariosis; Green fruit rot; Inter fruitlet corking; Leathery pocket; Water blister; White leaf spot (Chalaraparadoxa is common in pineapple plantations). The fungus is most active in warm, humid weather and will only infiltrate wounds; fruit rot caused by yeast and Candida species (disease can develop prior to or following harvest); diseases linked to nematodes. Diseases linked to phytoplasmas and bacteria are squiggling. The fruit's surface cracks from natural growth and the open flower are

the entry points for the bacteria. Fruits that are infected typically have low levels of acid and sugar. Mealybug wilt disease, a virus-associated illness, pink disease (the bacteria are thought to be carried by nectar-feeding insects and mites to open flowers from infected, decaying fruit near flowering fields), and yellow spot (the disease is rarely seen)[35].

Intercropping

It can be inferred that growing other crops alongside pineapple is a key factor in the respondents' increased income. In that region, intercrops like jackfruit, ginger, turmeric, and aroids are commonly grown[14,15]. Farmers should give careful consideration to growing these crops while adhering to all recommended practices in order to receive a healthy economic return. The increased income from unit area of pineapple cultivation of the study area's respondents was positively correlated with their education, farm size, annual income, knowledge, and attitude towards pineapple cultivation. The change agents need to focus more on properly addressing these issues in order to ensure that pineapple growers have a sustainable means of subsistence[9].

Harvesting and post-harvest management

It is possible to reduce damage to fruits and leaves when using the mechanical method, leading to the conclusion that a recently introduced mechanical device can minimize post-harvest losses in pineapple. Even small-scale farmers can afford the mechanical harvesting device because of its extremely low total production cost (LKR 12,500.00). Adding a lightweight motorized cutter can further enhance the mechanical device's performance[37].

Challenges and constraints

Institutional and technological limitations are a reflection of a larger problem of inadequate farmer support provided by agricultural extension. It is challenging for farmers, especially those who grow pineapples, to make progress in their production activities that is reasonable when the extension service is not meeting expectations[9].

Khalid et al. (2007) state that historically, horticultural crops, including fruits, were neglected in favour of increasing the productivity and production of major crops[6]. Furthermore, the majority of the nation's harvested produce is wasted, which could be brought on by ineffective marketing strategies, post-harvest losses, low technological advancements that make it easier to process high-quality pineapple products, and inefficient production methods (Ivan et al, 2011)[9].

Gumi and Aliero (2012) claim that pests and diseases deprive the world of over 40% of the potential yield of the eight most important food crops[7]. Weeds, illnesses, and pest infestations are examples of biotic stress factors that lower pineapple yield and quality, which significantly lowers the amount of money that can be made from producing pineapples[9].

A ready market, a source of income for farmers, a fertile land for pineapple production, and the promotion of good health through consumption were some of the benefits of pine apple production in the area. Technical, institutional, financial, and input obstacles, as well as production and biotic stress obstacles, all worked against the region's pineapple production[27].

Government and non-governmental organizations should support research to increase pineapple production (NGO). In addition, basic infrastructure needs like a well-built road network to facilitate the easy transportation of produce from the point of production to the market should be provided by the government, non-governmental organizations, and local authorities. By doing this, the losses and production damages incurred during transportation will be reduced[9].

It was ranked by lack of improved varieties. Even now, pineapple is regarded as a minor fruit. Unlike other crops, pineapple research is not being conducted by many research institutes. The reaction from pineapple growers is growing every day. The lack of a high-yielding contemporary variety of pineapple poses a significant challenge to pineapple cultivation in this instance.

Future prospects

Some of the main recommendations made by the pineapple growers were to create a pineapple processing factory, establish a farmers' association with the processing company, offer effective extension services, and train small local business owners in processing. The results of the multiple regression analysis showed that the respondents' total income, farm size, education level, and pineapple farm size were the main factors influencing the problems they faced.

Conclusion

While the climatic conditions in central Uttar Pradesh may not be ideal for pineapple cultivation, it is possible to grow pineapples with careful attention to soil management, irrigation, and temperature control. Selecting appropriate pineapple varieties that are better suited to subtropical conditions can also enhance the chances of successful cultivation. Additionally, practices like mulching, shading, and providing protection during extreme weather conditions can help mitigate the challenges presented by the local climate.

The climatic conditions in central Uttar Pradesh can pose certain challenges for pineapple cultivation, as pineapples are typically grown in tropical and subtropical regions. However, with proper care and management, it is possible to cultivate pineapples in this zone.

References

1. Benefits and uses of pineapple by P.P. Joy Kerala Agricultural University, https://www.researchgate.net/publication/306017037.
2. Pineapple Leaf Fibre: Cultivation and Production, by Pintu pandit, https://www.researchgate.net/publication/339248292
3. Collins JL (1949) History, taxonomy and culture of the pineapple. Econ Bot 3(4):335–359
4. Collins JL (1961) The pineapple: botany, cultivation and utilization. Pineapple Bot Cultivation Util
5. Mukherjee PS, Satyanarayana KG (1986) Structure and properties of some vegetable fibres. J Mater Sci 21(1):51–56

6. Johnson MO (1935) The pineapple. Pineapple
7. Abbasi MA, Jamal T (1999) Soil loss and runoff measurement from banana-pineapple intercropping system. Pak J Biol Sci 2(3):689–692
8. Impact of Pineapple Cultivation on the Increased Income of Pineapple Growers BY Shaikh Shamim Hasan, https://www.researchgate.net/publication/267404254
9. Problems and Prospects of Pineapple Production in Enugu State, Nigeria by Juliana Chinasa. Iwuchukwu, https://www.researchgate.net/publication/313489868
10. Bartholomew,D.P., Paul, R.E and Rohrbach, K.G., (2003). The pineapple: botany, production and uses. *Pests, diseases and weeds*. In. Bartholomew,D.P., Paul, R.E and Rohrbach, K.G. (eds.) CABI, Wallingford, UK, pp 1-301.
11. Food and Agriculture Organization (FAO) (2009). "A Case Study of Tropical Fruits in Asia, with special reference to Mangoes and Pineapples. Committee on Commodity Problems", Joint Meeting of the Fourth Session of The Sub-group on Bananas and The Fifth Session of The Sub-group on Tropical Fruits, Rome, 9 – 11 December 2009.
12. Joy, P. P. (2010). "Benefits and Uses of Pineapple", Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India. www.kau.edu/prsvkm.
13. Medina J.D. C. and Garcia, H. S. (2005). Pineapple Post-harvest Operations: INPhO-post-harvets Compendium. FAO Available online at: http://www.fao.org/3/a-ax438e.pdf. Retrieved on 28/11/2016.
14. Torres, R.A., Garcia, J.A.O. (2005). Diagnosis of pineapple Crop (Ananas comosus L) cultivation in Nayarit, Mexico. Acta Horticulturae 666, 43-49.
15. Lin, R.M.; Rahman, A.A. Status and impact of pineapple technology on mineral soil. Econ. Technol. Manag. Rev. 2010, 5, 11–19.
16. Pineapple Residue Ash Reduces Carbon Dioxide and Nitrous Oxide Emissions in Pineapple Cultivation on Tropical Peat Soils at Saratok, Malaysia by Liza Nuriati Lim Kim Choo 1,2,* , Osumanu Haruna Ahmed 2,3,4, Nik Muhamad Nik Majid 5 and Zakry Fitri Abd Aziz 2, https://www.mdpi.com/journal/sustainability.
17. Hardening of 'MD-2' Micropropagated Pineapple Plants by Drought to Improve the Acclimatization-field Transition by Rene Carlos Rodriguez Escriba, https://www.researchgate.net/publication/305692389
18. Aragón, C., Pascual, P., González-Olmedo, J.L., Escalona, M., Carvalho, L. y Amancio, S. (2013) The physiology of *ex vitro* pineapple (*Ananas comosus* (L.) Merr. var MD-2) as CAM or C3 is regulated by the environmental conditions: proteomic and transcriptomic profiles. Plant Cell Reports 32: 1807-1818.
19. Effects of potassium chloride and potassium sulphate on 'MD-2' pineapple fruit yield and quality, Newsletter, Pineapple Working Group, International Society for Horticultural Science , page 10.

20. Ahmed, O.H., Ahmad, H.M., Musa, H.M., Rahim, A.A. and Rastan, S.O. (2005). Applied K fertilizer use efficiency in pineapples grown on a tropical peat soil under residues removal. Scientific World Journal, 5, 42-49. doi: 10.1100/tsw.
21. Junqueira, L.A., Quaggio, J.A., Cantarella, H. and Vicari E. (2011). Potassium fertilization for pineapple: Effects on plant growth and fruit yield. Rev. Bras. Frutic., Jaboticabal - SP, 33, 618-626.
22. Leon, R.G. and Kellon, D. (2012). Characterization of 'MD-2' pineapple planting density and fertilization using a grower survey. Hortechnology, 22, 644-650.
23. Teixeira, L.A.J., Quaggio, J.A., Cantarella, H., and Mellis, E.V. (2011). Potassium fertilization for pineapple: effects on plant growth and fruit yield. Revista Brasileira de Fruticultura, 33, 618-626.
24. A preliminary report on irrigation of pineapples, Newsletter, Pineapple Working Group, International Society for Horticultural Science, page 39- 40.
25. Antony, E.; Taybi, T.; Courbot, M.; Mugford, S.; Smith, A.; Borland. 2008 A. Cloning, localization and expression analysis of vacuolar sugar transporters in the CAM plant *Ananas comosus* (pineapple). Journal of Experimental Botany, 59:1895–1908.
26. Malezieux, E., Cote, F., and Bartholomew, D.P. 2003. Crop environment, and vegetative physiology and growth. 69-107, p. 320. In: Bartholomew, D. P., Paull, R., and Rohrbach, K. G. (eds.), The Pineapple: Botany, Production and Uses. CABI Publishing, Wallingford.
27. Identify Problems and Suggest Possible Solutions for Safe Pineapple Production in Madhupur Tract, Shahriar Hasan, https://www.researchgate.net/publication/364237950
28. Department of Agriculture (2015) Pineapple. Available at:https://www.doa.gov.lk/FCRDC/index.php/en/[Accessed 02 Apr. 2021].
29. Food and Agricultural Organization (2013) Small Scale Postharvest Handling Practices, In: Harvesting and Preparation for Market. Retrieved fromhttp://www.fao.org/docrep/009/ae075e/ae075 e04.htm [Accessed25 May 2021].
30. Joy P (2016) Harvesting and post-harvest handling of Pineapple. Available at: https://www.researchgate.net/publication/3081713 77_Harvesting_and_postharvest_ handling_of_pineapple [Accessed 09 April 2021].
31. Hossain MF, Akhtar S, Anwar M. Nutritional value and medicinal benefits of pineapple. International Journal of Nutrition and Food Sciences. 2015 Jan;4(1):84-8.
32. Umi HN, Tricahya RA, Farid AM. Performance analysis of drip and sprinkler irrigation on pineapple cultivation. InIOP Conference Series: Earth and Environmental Science 2020 Mar 1 (Vol. 451, No. 1, p.012034). IOP Publishing.
33. Afzal MF, Siddiqui SH, Farrukh S. Growth analysis of productivity, dispersal and profitability of Pineapple in India. American International Journal of Research in Humanities, Arts and Social Sciences. 2018;25(1):76-82.
34. Hasan SS, Ali MA, Khalil MI. Impact of pineapple cultivation on the increased income of pineapple growers. The Agriculturists. 2010;8(2):50-6.

35. Sapak, Z.; Mohd FaisolMahadeven, A.N.; Nurul Farhana, M.H.; Norsahira, S.; Mohd Zafri, A.W. A review of common diseases of pineapple: The causal pathogens, disease symptoms, and available control measures. Food Res. 2021, 5, 1–14. [CrossRef][PubMed].
36. Design, Development, and Performance Evaluation of a Mechanical Device for Harvesting Pineapple by P. D. Kahandage1, S. W. Hettiarachchi1, G. V. T. V. Weerasooriya1, E. J. Kosgollegedara1, S. D. S. Piyathissa2, International Journal of Trend in Scientific Research and Development (IJTSRD), Volume 5 Issue 4, May-June 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470.