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Ningdalli Mallikarjun
Scientist (Horticulture), ICAR-
Krishi Vigyan Kendra, Bidar,
Karnataka, India

Sunilkumar NM
Senior Scientist and Head,
ICAR- Krishi Vigyan Kendra,
Bidar, Karnataka, India

Akshaykumar
Assistant Professor, Department
of Dairy Microbiology, Dairy
Science College, Mahagaon Cross,
Kalaburagi, Karnataka, India

Gnyandev B
Scientist (Seed Science and
Technology), ICAR- Krishi
Vigyan Kendra, Bidar,
Karnataka, India

Corresponding Author:
Ningdalli Mallikarjun
Scientist (Horticulture), ICAR-
Krishi Vigyan Kendra, Bidar,
Karnataka, India

Study on effectiveness of 'ARKA mango special' for higher yield and quality of mango variety 'Kesar' in red loam soils of Bidar district of Kalyan Karnataka

Ningdalli Mallikarjun, Sunilkumar NM, Akshaykumar and Gnyandev B

Abstract

In recent times, there has been a growing interest among fruit cultivators in utilizing micronutrients due to their advantageous nutritional contributions. This trend is driven by the desire for improved yields and more favorable returns. With the aim of promoting this concept to mango cultivators in the region, an initiative was undertaken by the ICAR-Krishi Vigyan Kendra in Bidar, Karnataka, India. From 2018 to 2021, they conducted practical demonstrations in the fields of farmers. The primary objective was to instill confidence in and persuade mango growers regarding the positive effects of applying foliar micronutrients, particularly the 'Arka Mango Special' formulation developed by IIHR in Bengaluru. This formulation is designed to adequately supply essential micronutrients to the plants, thereby enhancing the yield and quality of mango fruits. The demonstration encompassed 15 individual farmers' orchards, each covering an acre of land. A randomized block design was adopted, incorporating two distinct treatments: T₁ involved the control practice of spraying normal water, while T₂ encompassed the application of 'Arka Mango Special' at a rate of 0.5%. In both treatments, four foliar sprays were administered annually. These sprays were strategically timed before flowering, during flower bud differentiation, at flower initiation, and during the marble stage of fruit growth. The results of the foliar micronutrient treatment were notably positive, leading to improvements in fruit retention, yield, and overall quality. Among the outcomes, the application of 'Arka Mango Special' yielded the most promising results. At the pea stage, it achieved the highest count of fruits per panicle (5.04), the greatest number of fruits per tree (192.4), and a superior fruit yield (7.55 t/ha) compared to the control, which represented the farmers' conventional practice.

Keywords: Arka mango special, foliar nutrition of micronutrients, red loamy soil, fruit let drop and mango yield

Introduction

Mango (*Mangifera indica* L.) stands out as a significant tropical fruit globally. Its distinctive title as the "king of fruits" is attributed to its exceptional nutritional content, distinct fragrance, and unparalleled flavor. This fruit holds a prominent place, accounting for nearly fifty percent of all tropical fruit production worldwide. Its versatility in adapting to diverse climatic and soil conditions, coupled with its diverse varieties and substantial yield, contribute to its unique flavor and captivating aroma. India proudly designates the mango as its 'National Fruit'. This esteemed fruit is cultivated across both tropical and subtropical regions.

In India, the annual mango production reaches an impressive 10.99 million tonnes, cultivated over 1.23 million hectares of land, securing the nation's position as the leading mango producer globally. Within India, key mango-growing states include Andhra Pradesh, Uttar Pradesh, Telangana, Karnataka, and Gujarat. In the context of Karnataka, mangoes thrive across 1.63 lakh hectares of land, yielding an annual production of 20 lakh tonnes. Despite this substantial production volume, the mango crop's productivity remains relatively low. This situation arises primarily due to the prevalence of marginal soils in which mango orchards are often situated. Around 80% of these soils are deficient in essential micronutrients. The crop's response to soil pH in an acidic environment is well-documented, particularly concerning the availability of micronutrients like boron (B) and zinc (Zn). Zinc is pivotal in various enzymatic reactions, as well as in protein and carbohydrate metabolism, along with the synthesis of the growth hormone auxin. Conversely, boron plays a crucial role in fundamental processes such as cell division, cell development, calcium metabolism, ovule development, pollen tube growth, fruit setting, and sugar translocation within plants.

Given these roles, a deficiency in zinc and boron within a mango crop can lead to reduced fruit production and increased fruit drop across different stages of fruit development. These micronutrients are integral to a range of plant metabolic processes, spanning from cell wall formation to essential functions like respiration, photosynthesis, chlorophyll synthesis, enzymatic activity, hormone production, as well as nitrogen fixation and reduction (Das, 2003) [3]. This intern will give way for reduction in yield and fruit quality. The present intervention is concentrated to the variety Keshar As it grown extensively in the Bidar district. The Keshar variety is a leading cultivar with a red blush on the shoulders. It is the early maturing variety with good processing quality among the different variety grown in Bidar district the taste of the fruit is accepted by many consumers as it has the TSS: 18-22 °Brix

The Indian Institute of Horticultural Research (ICAR) has developed a specialized foliar nutrition formulation named "Arka Mango Special." This formulation serves the purpose of mitigating micronutrient deficiencies encountered by crops in diverse soil types. Comprising a range of secondary and micronutrients such as Zn, B, Fe, Cu, Mo, and S, it has proven to be effective in rectifying deficiencies, especially in Zn and B, prevalent in red loamy soils. This deficiency is often linked to reduced flower retention, early fruit drop, and compromised fruit quality in mango plants. By addressing these concerns, "Arka Mango Special" has demonstrated its capacity to enhance production levels. The practice of fertilizing with both micro and macronutrients holds substantial sway over the overall yield and quality of the harvested fruit. Recognizing this, the present demonstration was meticulously designed and executed to evaluate the efficacy of "Arka Mango Special" in augmenting mango yield within the context of red loamy soils characteristic of the Bidar district.

Materials and Methods

The demonstration was executed within the farmer's fields situated in Bidar District, Karnataka, spanning from 2019 to 2021. The chosen orchards maintained a medium density layout, with a spacing of 7 meters between rows and again 7 meters between two adjacent plants in each row. All of these orchards exclusively housed the 'Keshar' variety of mango. These particular orchards were established back in 2011, on the characteristic red loamy soils of the region. Two distinct treatments were applied for comparison: T₁ involved the control group where no micronutrients were applied, and T₂ comprised the application of 'Arka Mango Special' at a rate of 0.5%. Within each treatment, a total of 10 plants were selected, tagged, and monitored for the study. The micronutrient formulation, including 'Arka Mango Special' and the IIHR micronutrient formulation, was sourced from IIHR in Bengaluru. The micronutrients were administered via foliage in four rounds of spraying. The first spray took place pre-flowering, the second during flower bud differentiation and flower initiation, and the last following fruit set when the fruit exhibited the marble-like stage of maturity. For the control group (T₁), plants were subjected to spraying with

normal water. Notable observations were made regarding the flowering and fruiting behaviors, encompassing factors like the percentage of flowering shoots, panicle dimensions in centimeters, the proportion of hermaphrodite flowers, and the count of fruits per panicle during the peanut stage. During harvesting, the number of fruits retained per panicle was documented, along with parameters influencing yield, including yield (in kilograms per tree), average fruit weight (in grams), and the number of fruits per plant.

The percentage of flowering shoots per square meter of canopy was calculated. The 20 panicles in each tagged tree that were spread in the four directions at full bloom stage were selected at random to record various fruiting and blooming characteristics. The panicle's length and width were measured using the measuring tape. % of the hermaphrodite flower was calculated using the formula below:

$$\text{Hermaphrodite flower (\%)} = \frac{\text{No. of hermaphrodite flower/ panicle}}{\text{Total no. of flowers /panicle}} \times 100$$

Fruits were picked when fully mature. The fruits that were collected were weighed using a physical balance, hence the yield is given in kilograms per tree. By dividing the fruit output by the total number of fruits, the average fruit weight was calculated.

Results and Discussion

The impact of foliar nutrition using the Arka Mango Special formulation (micronutrients) on the characteristics of flowering, fruit setting, development, and retention is summarized in Table 1. Based on the aggregated data from three years of observation, it becomes evident that the application of four rounds of micronutrient sprays during crucial stages like pre-flowering, flower bud differentiation, flower initiation, and the marble stage of fruit growth has yielded significant effects on both the total number and size of panicles. The outcomes demonstrate a notable influence on the production of hermaphrodite flowers, their successful conversion into fruits, and their subsequent retention, collectively contributing to the final yield. This is attributed to the increased count of panicles in the treated group.

There was a remarkable increase in the number of fruits per panicle during both the peanut stage and the harvesting phase of fruit growth. Particularly during the pea stage, the highest count of fruits per panicle (1.68) was recorded. The presence of micronutrients such as B and Zn in the treatment likely played a role in elevating the number of fruits per panicle during these stages. Prior research, including the current study and existing reviews, underscores that Zn plays a role in mitigating fruit drop across various growth stages by promoting the synthesis of auxin, a growth hormone that delays the formation of the abscission layer. Similarly, boron's role in enhancing pollen grain germination and the elongation of pollen tubes aids in fruit setting, as supported by findings from Stino *et al.* (2011) [10] and Deepa *et al.* (2018) [12] in the context of mango cultivation.

Table 1: Influence of Arka Mango Special Foliar Nutrition on Flowering of Mango Variety 'Kesar' in Bidar District.

| Treatment | Number of panicles / plants | Dimension (cm) | | Hermaphrodite flowers per panicle | Number of Fruits per Panicle at Pea Stage (%) | Number of retained fruits per panicle |
|-----------------------|-----------------------------|----------------|--------|-----------------------------------|---|---------------------------------------|
| | | Width | Length | | | |
| Demonstrated practice | 42.92 | 25.97 | 41.08 | 136.42 | 5.04 | 1.68 |
| Farmers practice | 41.77 | 24.78 | 40.05 | 119.46 | 4.92 | 1.39 |

Impact of Foliar Micronutrient Nutrition on Yield

According to data on fruit yield (Table 2), it was highest for the exhibited plot (43.17 kg/tree) and lowest for the farmer practice-control plots (39.02 kg/tree). The flowering shoot percentage (Table 1) there was increase in yields and fruit production per tree. This suggests that keeping more fruits per panicle, or 1.68 (Table 1), may have led to a higher number of fruits being harvested per tree (192.4). The greatest results for fruit weight were seen in instance T1, where (Arka Mango Special) absorbed micronutrient spray at a rate of 224.4/fruit. However, it was noticed that the variations in average fruit weight between the two treatments were statistically

equivalent. Consequently, the heightened fruit yield observed in trees subjected to micronutrient sprays can primarily be attributed to an augmented fruit count per tree, as opposed to a substantial increase in individual fruit weight. Comparable findings indicating yield improvement due to the application of zinc (Zn) and boron (B) have also been documented in the cases of Ber and Cashew trees, respectively. This alignment with our findings is reaffirmed by the studies conducted by Samant *et al.* (2008) ^[9], Gaur *et al.* (2014) ^[4], and Lakshmipathi *et al.* (2015) ^[6], all of which support and align with the outcomes observed and presented in this study.

Table 2: Impact of Arka Mango Special Foliar Nutrition on Mango Variety 'Keshar' Fruit Yield in Bidar District.

| Treatment | No. of fruits/tree | Average fruit weight (g/fruit) | Fruit yield | |
|-----------------------|--------------------|--------------------------------|-------------|--------|
| | | | (kg/tree) | (t/ha) |
| Demonstrated practice | 192.4 | 224.4 | 43.17 | 7.55 |
| Farmers practice | 186.7 | 208.9 | 39.02 | 6.82 |

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