EFFECT OF FOLIAR APPLICATION OF MICRONUTRIENTS ENRICHED HUMIC ACID AND GIBBERELLIC ACID ON THE FRUIT AND NUT YIELD OF CASHEW

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ABSTRACT: Micronutrient disorders are commonly observed during the early stage as well as the full grown stage of cashew. Application of micronutrients as foliar spray was very effective in cashew as compared to soil application. Addition of humic acid with micronutrients improves the effectiveness of micronutrient foliar spray in crops. Foliar application of GA3 at pre blooming stage of cashew was established as an effective growth regulator in improving the yield of cashew.The present investigation was carried out to study the effect of foliar application of micronutrients enriched humic acid on growth and yield of cashew cultivar VRI-3 with the objective to improve nut yield. This experiment was carried out in a farmer's field at periyakappankulam, Cuddalorer District of Tamil Nadu. The trial was laid out in randomized block design (RBD) with eight treatments and replicated thrice. The treatments consist of T_1-control (water spray), T2-micronutrient mixture (0.5% $ZnSO_4$, 0.5% $FeSO_4$, 0.2% $CuSO_4$, 0.5% Borax, 0.2% $MnSO_4$), T_3-Humic acid (0.5%), T_4-GA_3 (50 mg L^{-1}), T_5-T_2+T_3, T_6-T_2+T_4, T_7-T_3+T_4, T_8-T_2+T_3+T_4. The present study revealed that the combined application of micronutrient mixtures along with Humic acid and GA_3 as foliar spray (T_8) recorded the highest value for the characters namely average apple weight (61.6 g), number of fruits per tree (2025), average nut weight (7.50 g), 100 nut weight (672.6 g), yield per tree (17.66 kg $tree^{-1}$) and nut yield (2.90 t ha^{-1}), followed by the treatment T_5, which recorded the average apple weight (59.86 g), number of fruits per tree (1956), average nut weight (7.38 g), 100 nut weight (666.6g), yield per tree (16.57 kg $tree^{-1}$) and estimated yield per ha (2.78 t ha^{-1}). Based on the nut yield, the treatments are arranged in dissenting order as T_8>T_5>T_6>T_2>T_7>T_4>T_3>T_1. However, the control (water spray) recorded the lowest value in all the traits.

Key words: cashew,micronutrients,humic acid,gibberellic acid

INTRODUCTION

Cashew (*Anacardium occidentale* L.) belongs to the family Anacardiaceae and is native to Brazil. It was introduced into India by Portuguese in the 16th century for afforestation and soil conservation. India was the first country in the world to exploit inter-national trade in cashew kernels in the early part of 20th century (Chavan and Raut, 2013). It earns valuable foreign exchange for the country and is therefore regarded as a "gold mine". Tree nuts are globally consumed for their desirable sensory and nutritional attributes. Among dry fruits, cashew nuts are very popular due to their characteristic odour and taste. Cashew nuts are a good source of proteins (20%), carbohydrates (23%) and fats (45%) (Bhattacharjee *et al.,* 2003). Cashew shells contain high quality oil known as cashew nut shell liquid (CNSL) which has several industrial applications. Value added products such as juice, *fenni*, wine, dried cashew apple, syrup and jam can be prepared from cashew apple (Suganya and Dharshini, 2011). The global production of cashew is around 43,10,027 MT from a total of 53,13,415 hectares (FAO, 2012). India is the second largest producer of raw cashew in the world, next only to Vietnam. India produces about 0.75 million MT of cashew from an area of 1.01 million hectares with a productivity of 0.7 MT ha^{-1} (NHB, 2014). Prolonged flowering, poor production of perfect flowers, narrow sex ratio and low fruit set are some major problems plateauing cashew cultivation across the country. Over the years, application of micronutrients and exogenous hormones has significantly improved flowering and fruiting in cashew (Konhar and Mech, 1988). Aliyu et al., 2011 reported that foliar sprays of Gibberellic acid (GA_3) to cashew increased the production of perfect flowers and improved the sex ratio in flowers. Micronutrient disorders were commonly observed during the early stage as well as the full grown stage of cashew. Application of micronutrients as foliar spray was very effective in cashew as compared to soil application. Addition of humic acid with micronutrients improves the effectiveness of micronutrient foliar spray in crops.GA_3 foliar spray at pre blooming stage of cashew was established as a effective growth regulator in improving the yield of cashew The present investigation was carried out to study the effect of foliar application of micronutrients enriched humic acid on growth and yield of cashew cultivar 'VRI-3' with an objective to improve nut yield

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MATERIALS AND METHODS

An experiment was conducted on seven year old cashew trees of var.VRI-3 grown on lateritic soils during the fruiting season of 2015-2016 in a farmer's field at periyakappankulam, Cuddalorer District of Tamil Nadu. The trial was laid out in randomized block design (RBD) with eight treatments and replicated thrice. The treatments consist of T_1-control (water spray), T_2-micronutrient mixture (0.5%-$ZnSO_4$, 0.5%-$FeSO_4$, 0.2%-$CuSO_4$, 0.5%-Borax, 0.2%-$MnSO_4$), T_3-lignite humic acid (0.5%), T_4-GA_3 (50 mg L^{-1}), T_5-T_2+T_3, T_6-T_2+T_4, T_7-T_3+T_4, T_8-T_2+T_3+T_4. The climate of the region is semi arid, with an annual rainfall of 1216 mm and temperature range of 22.0°C to 38.70°C. The experimental site is located at an elevation of 41.9 M above mean sea level. Three sprays of each treatment were given as follows: i) before the vegetative flush, ii)

after the vegetative flush and iii) during fruit-set. Recommended package of practices was followed uniformly, including plant protection. Observations were recorded on number of laterals before and after spray, number of flowering panicles per m^2, flowering duration, number of staminate and perfect flowers, fruit-set per m^2, number of nuts per panicle, nut weight and nut yield. Number of staminate and perfect flowers was recorded every day till completion of flowering. Sex ratio was calculated using the formula developed by Abdul Halim Hassan *et al* (1988)

RESULTS AND DISCUSSION

Number of fruits and apple weight

Foliar application of micronutrients mixture, humic acid (HA) @ 0.5 per cent and Gibberellic acid (GA) @ 50ppm either alone or in combination favourably improved the number of fruits and average apple weight. Among the eight treatments, application of micronutrient mixture (MNM) along with humic acid (HA) @ 0.5 per cent and Gibberellic acid (GA) @ 50 ppm (T_8) recorded the higher number of fruits of 2025 and average apple weight of 61.6g. This was followed by T_5, which is applied with micronutrients enriched humic acid. The treatments T_4 and T_7 were found to be on par with each other. Though sole application of micronutrients mixture, humic acid and gibberellic acid showed a significant improvement in respect of number of fruits and fruit weight over control, it is inferior to treatments which received the combination of MNM, HA and GA. The increase in fruit number and fruit weight due to addition of micronutrient mixture, might be due to role of Zn and B in the flower initiation, fruit retention and transport of photosynthate to flower parts (Dutta,2004). The enrichment of humic acid (0.5%) and Gibberellic acid (50ppm) in flower retention, cell division and cell elongation might also have increased the fruit retention and fruit weight.

Nut weight and 100 nut weight

Nut weight is an important parameter in cashew which decides the grade of kernel. Foliar application of micronutrients mixture (Zn + B) either alone or in combination of with HA or GA and or both significantly increased the average nut weight and 100 nut weight of cashew. Foliar application of micronutrients (Zn + B) was significantly superior to humic acid and Gibberellic acid in respect of nut weight and 100 nut weight. Foliar application of MNM along with HA recorded the higher nut weight of 7.3g and 100 nut weight of 666.6g as compared to treatment T_6 (MNM + GA_3) and T_7 (HA + GA_3). The highest nut weight and 100 nut weight of 7.5 g and 672.6 g were recorded in the treatment T_8, which received the foliar spray of micronutrients enriched with HA (0.5%) and GA_3 (50ppm). The better availability of Zn and B at flowering and effective transport of photosynthate to nuts might be the reason for increased nut weight and 100 nut weight (Babu and Singh, 2001).Humic acid also has the role of improving the nutrient and water uptake by plants (Dhanasekaran and Bhuvaneswari,2007).Increased in nut weight of cashew due to foliar application of micronutrients to cashew was reported by Lakshmipathi et al,2015

Nut yield

Foliar nutrition of micronutrients to cashew showed a positive response in terms of nut yield $tree^{-1}$. Combined application of micronutrient mixture with humic acid (T_5) recorded higher nut yield as compared MNM (T_2) alone. The treatments T_5 and T_7 were found to be on par with each other in respect of nut yield $tree^{-1}$.

Among the treatments, foliar application of humic acid along with HA and GA_3 recorded the highest nut yield of 17.66 kg $tree^{-1}$ and 2.9 t ha^{-1} respectively. The increased number of nuts per tree as observed in number of fruits and nut weight in the micronutrient enriched humic acid treatments might be the reason for the increased nut yield of cashew.

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Table 1. Effect of micronutrients enriched Humic acid and Gibberellic acid on number of fruits and average fruit weight of Cashew

Treatments	Number of fruits tree^{-1}	Average apple weight (g)
T_1 – Control	1765	40.2
T_2 – Micronutrient mixture (MNM)	1890	54.0
T_3 – Humic acid (HA) @ 0..5 %	1804	45.6
T_4- Gibberellic acid (GA_3) @ 50ppm	1865	50.4
T_5 - MNM + HA	1956	59.9
T_6 - MNM + GA_3	1901	58.0
T_7 - HA + GA_3	1864	52.8
T_8 - MNM + HA + GA_3	2025	61.6
CD (p=0.05)	**28.0**	**1.1**

Table 2. Effect of micronutrients enriched Humic acid and Gibberellic acid on average nut weight and 100 nut weight of Cashew

Treatments	Average nut weight (g)	100 nut weight (g)
T_1 – Control	6.15	580.2
T_2 – Micronutrient mixture (MNM)	7.00	648.0
T_3 – Humic acid (HA) @ 0..5 %	6.50	600.8
T_4- Gibberellic acid (GA_3) @ 50ppm	6.60	615.0
T_5 - MNM + HA	7.38	666.6
T_6 - MNM + GA_3	7.12	657.4
T_7 - HA + GA_3	6.80	624.0
T_8 - MNM + HA + GA_3	7.50	672.6
CD (p=0.05)	**0.50**	**12.5**

Table 3. Effect of micronutrients enriched Humic acid and Gibberellic acid on nut yield tree^{-1} and nut yield ha^{-1} of Cashew

Treatments	Nut yield tree^{-1} (kg)	Nut yield (t ha^{-1})
T_1 – Control	10.80	1.98
T_2 – Micronutrient mixture (MNM)	15.00	2.40
T_3 – Humic acid (HA) @ 0..5 %	12.70	2.15
T_4- Gibberellic acid (GA_3) @ 50ppm	13.80	2.20
T_5 - MNM + HA	16.57	2.78
T_6 - MNM + GA_3	15.94	2.58
T_7 - HA + GA_3	14.06	2.27
T_8 - MNM + HA + GA_3	17.66	2.90
CD (p=0.05)	**0.22**	**0.15**