Effect of Biozyme T.F. on yield and quality of tomato (*Lycopersicon esculentum*)

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ABSTRACT

The effect of Biozyme T.F., a foliar fertilizer, on the growth and yield of tomato was determined. Plants were treated with Biozyme T.F. concentrations of 250, 500 and 700 cc ha^{-1}. Plants treated with Biozyme T.F. increased percent fruit set, mean number of fruits per plant, fruit weight, fruit diameter, mean number of locules per fruit, and number of seeds per fruit. Applying Biozyme T.F., especially at 500 cc ha^{-1}, resulted in significantly higher fruit yield. Biozyme T.F. did not affect fruit *p*H.

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RÉSUMÉ

OFOSU-ANIM, J., BLAY, E. T. & BENING, L. : *Effet de Biozyme T.F. sur le rendement et la qualité de tomate* (Lycopersicon esculentum) Une expérience était entreprise pour déterminer l'effet de Biozyme T.F., un engrais foliaire, sur la croissance et le rendement de tomate. Les plantes étaient traitées avec Biozyme T.F. de concentrations de 250, 500 et 700 cc ha^{-1}. Les plantes traitées de Biozyme augmentaient le pourcentage de nouaison de fruit, nombre moyen de fruit/plante, poids de fruit, diamètre de fruit, nombre moyen de loges / fruit et nombre de graines/fruits. Appliquant Biozyme T.F. surtout à 500 cc ha^{-1}, résultait en un rendement de fruit considérablement plus élevé. Biozyme T.F. n'a pas touché le *p*H de fruit.

Introduction

Tomato is one of the most important crops in the established dry season gardens in the Northern, Upper, and southern Volta regions in Ghana. Other important areas of production are Greater Accra and Akumadan and Wenchi districts of the Brong Ahafo Region. Peasant and commercial farmers grow the crop which may be either rainfed or irrigated, depending on the accessibility of the producer to water source. The area under tomato production in Ghana is about 37,000 ha with a total yield of 277,000 metric tones (FASDEP, 2002). However, this production level is inadequate for the nation and as such processed tomato products continue to be imported annually.

The supply of fresh tomatoes decreases dramatically from mid-November to late March in southern Ghana as a result of low fruit set caused by high night temperatures and nutrient deficiency which result in flower and fruit drop (Sinnadurai & Amuti, 1992). To satisfy the high demand for tomatoes during this period, the need is to find ways of improving fruit set by reducing flower and fruit abortion and, thus, increase fruit yield. Foliar feeding has been used as a means of supplying supplemental doses of minor and major

nutrients, plant hormones, stimulants, and other beneficial substances to plants and, thus, increases fruit set (Lovatt, 1998; Lovatt, 1999). In nutrient absorption, foliar fertilization can be from 8 to 20 times as efficient as ground fertilization (Anon., 1985). Observed effects of foliar fertilization have included yield increases, resistance to diseases and insect pests, improved drought tolerance, and enhanced crop quality (Kuepper, 2003; Vorayos *et al*., 1992; Torre, Leandri & Imbroglini, 1992).

The objective of this study was to determine the response of tomato to applying Biozyme T.F., a foliar nutrient.

Materials and methods

The University of Ghana Farm, Legon, was used for the study between November and March in 2002 and 2003. Seedlings were transplanted to the field 3 weeks after germination at a spacing of 80 cm × 40 cm. A starter solution containing 6 g l^{-1} of NPK (15-15-15) was applied to all seedlings at 100 ml per plant. The experimental design was a randomized complete block design with four replications.

In a preliminary trial in the Sinna Garden of the Department of Crop Science, University of Ghana, Biozyme T.F. at different concentrations were applied to tomato plants at 50 per cent flowering in the morning and the promising rates selected for use in the field study. Treatments used were the control (plants sprayed with distilled water) and three concentrations of Biozyme T.F. – 250 cc ha^{-1} (half recommended rate), 500 cc ha^{-1} (recommended rate), and 750 cc ha^{-1} (1.5 × recommended rate). Biozyme T.F. contains auxin, gibberellin, zeatin, Fe, Mn, Mg, Zn, B, and S. It is reported to enhance endogenous hormonal balance in plants, cause cellular differentiation, and stimulate growth and uniformity in flowering (Manufacturer's manual). Plants were pruned to two stems and staked. At 50 per cent flowering, Biozyme T.F. was sprayed on treatment plants in the morning using a hand sprayer. To control insect pests, Actellic 25E was applied once a week at a concentration of 2 ml l^{-1}. Watering and weeding were done as and when necessary. Harvesting of fruits started at about 9 weeks after transplanting when fruits were red ripe.

Data were collected on growth, yield and quality characteristics; mean number of days to 50 per cent flower set, chlorophyll content of leaves using a chlorophyll meter (Minolta SPAD-502), mean number of branches per plant, percent fruit set, number of fruits per plant, number of fruits per truss, mean fruit weight, mean number of locules per fruit, number of seeds per fruit, total soluble sugars (by using a hand refractometer), and *p*H of fruits (by squeezing out juice from fruits and measuring with a *p*H meter).

Results and discussion

No significant differences were recorded between the chlorophyll content of leaves of Biozyme T.F.-treated plants and those of the control (Table 1). However, plants treated with the foliar fertilizer had slightly higher leaf chlorophyll content. Biozyme T.F. contains auxin which increases the chlorophyll content of leaves (Ayala-Silva *et al*., 2004). The number of branches on treated plants increased slightly with increased concentration of Biozyme T.F. (Table 1). The average internode length per plant for most treatments did not show significant differences, though plants treated with Biozyme T.F. had longer internodes which increased with increased concentration. Biozyme T.F. contains gibberellic acid, a plant growth regulator reported to increase stem elongation and, hence, internode length (Buchanan, Gruissem & Jones, 2000).

Foliar fertilizer treatment induced significant differences in fruit set. The highest percentage fruit set (39.68%), representing an increase of 43.6 per cent, was observed when plants were treated with Biozyme T.F. at 250 cc ha^{-1}. Fruit set is dependent on seeds producing signal molecules that regulate cellular division and expansion. Auxin, one of the components of Biozyme T.F., is a candidate for such signal molecules (Magnus *et al*., 1997). Biozyme T.F. contains cytokinins

TABLE 1

Effect of Biozyme T.F. on Growth Parameters of Tomato

Treatment	*Chlorophyll content of leaves (SPAD)*	*Mean number of branches*	*Length of internode (cm)*	*Plant height at harvest (cm)*
Control	37.03	1.59	42.49	102.1
Biozyme T.F. 250 cc	37.92	1.51	45.75	111.8
Biozyme T.F. 500 cc	38.01	1.52	46.31	112.9
Biozyme T.F. 750 cc	38.03	1.56	48.59	118.1
LSD (5%)	NS	NS	NS	NS

which might have also stimulated cell division, increased sink activity to improve the ability of developing fruits to compete for resources (Bower & Cutting, 1988) and, thus, improving fruit set.

Significant differences were observed in the number of fruits per truss after treating plants with Biozyme T.F. The highest number of fruits per truss was recorded in plants treated with Biozyme T.F. concentration of 250 cc ha^{-1} (Table 2). The observed increase in fruit numbers may be attributed to the synergistic effect of the plant growth regulators present in the foliar fertilizer. The mean weight of fruits ranged from 35.70 to 37.70 g. Though Biozyme T.F treatment did not significantly increase fruit weight, fruits on Biozyme T.F.-treated plants were generally bigger. These observations on the yield characteristics of tomato in this study could be attributed to the synergistic effect of gibberellin, IAA, and cytokinins. High levels of cytokinins (Cutting, 1993; Cowan *et al*., 1997), gibberellic acid (Salazar-Garcia & Lovatt, 2000), and auxin (Vanderpuije, 1998) during early fruit development are critical for obtaining large-sized fruits. These plant growth regulators might have altered the partitioning of photosynthates into the fruits of Biozyme T.F.- treated plants.

The differences were significant between the control and all Biozyme T.F. treatments in seed numbers. Seed numbers were higher in Biozyme T.F. treatments, but reduced as the concentration of Biozyme T.F. increased. The higher seed numbers observed in the Biozyme T.F. treated plants could be due to photo-assimilate partitioning into developing fruits on Biozyme T.F.-treated plants which finally supported seed development.

Table 2 shows the effect of Biozyme T.F. on fruit yield. The highest yield of 7.52 t ha^{-1} was recorded by treating plants with Biozyme T.F. at 500 cc ha^{-1}, which was a 40 per cent increase over the yield for the control plants. The recorded

TABLE 2

Effect of Biozyme T.F. on Yield and Yield Components of Tomato

Treatment	*Fruit set (%)*	*Mean number of fruits/truss*	*Mean number of fruits/plant*	*Mean fruit weight (g)*	*Fruit yield (t ha^{-1})*
Control	27.64	1.25	4.88	35.70	5.44
Biozyme T.F. 250 cc	39.68	1.62	6.56	35.69	6.79
Biozyme T.F. 500 cc	38.29	1.70	6.09	36.69	7.52
Biozyme T.F. 750 cc	32.67	1.36	5.56	37.70	6.55
LSD (5%)	6.41	0.34	0.24	NS	0.86

TABLE 3

Effect of Biozyme T.F. on Quality Attributes of Tomato

Treatment	*Fruit diameter (cm)*	*Mean number of locules*	*Number of seeds/fruit*	p*H of fruit*	*Total soluble solids (% Brix)*
Control	5.7	7.05	127	4.13	5.30
Biozyme T.F. 250 cc	6.53	7.40	171	4.07	5.66
Biozyme T.F. 500 cc	6.40	7.50	158	4.10	5.61
Biozyme T.F. 750 cc	6.58	7.03	155	4.13	4.88
LSD (5%)	NS	0.3	9.8	NS	0.87

increase in yield of Biozyme T. F.- treated tomato plants could be attributed to the micro-nutrients or the synergistic effects of the hormones contained in Biozyme T.F. or both (Navrot & Levin, 1976). Padem *et al.* (1999) reported an increase in yield and yield characteristics after treating tomato with a foliar fertilizer.

The *p*H of fruits was not significantly affected by the treatments. The *p*H of tomato fruits is neither related to cultural practices nor to varietal characteristics (Norman, 1974; Villareal, 1988). The total soluble sugars decreased with increasing concentration of Biozyme T.F. (Table 3). The reduction in chlorophyll content of leaves as concentrations of both hormones increased might have accounted for low amount of sugars synthesized and imported into fruits.

Conclusion

Biozyme T.F. increased total fruit yields in treated plants, slightly increased the chlorophyll content of the leaves, and increased seed number per fruit. Biozyme T.F. increased the total soluble sugars of the fruits, but did not affect fruit *p*H. Biozyme T.F. seemingly played a significant role in enhancing the yield of tomato, and may be applied at a rate of 500 cc ha^{-1} for maximum effect.

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