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Evaluation of Tradecorp AZ Bentley plus Fertilizer for Tomato Crop Yield Improvement under Irrigation in East Shoa Zone of Oromia, Ethiopia

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Abstract

Ethiopia was using urea and DAP fertilizers as sources of nitrogen and phosphorous nutrients for a long time. However, the crop and agro-ecology diversity in the country demand more multi-nutrient blends including micronutrients than nitrogen and phosphorus. This increasing demand requires evaluation of different fertilizer resources based on soil type, crop species, and location to provide new alternative fertilizer products to Ethiopian production system. Cognizant of this fact, an experiment was conducted to evaluate the efficacy of Tradecorp AZ Bentley plus as a supplementary fertilizer to improve yield of tomato under irrigation in different areas in east Shoa Zone of Oromia, during 2018-2019. The experiment consisted of five treatments (Control, recommended fertilizer, recommended fertilizer + 1.8 kg product, recommended fertilizer + 3.0 kg product and recommended fertilizer + 4.2 kg product) laid out in randomized complete block design (RCBD) with four replications. The results revealed that application of Tradecorp AZ Bentley plus fertilizer product improved tomato marketable and total yields at testing sites. In addition, the application of Tradecorp AZ Bentley plus as supplementary fertilizer in combination with the recommended fertilizer rate attained acceptable net returns of tomato at both locations. Hence, Tradecorp AZ Bentley plus is recommended as supplemental fertilizer for tomato producing farmers in testing areas.

Keywords: East Shoa, Tomato yield, Tradecorp AZ Bentley plus

Introduction

Tomato (*Solanum lycopersicum* L.) is a vegetable crop with high potential to contribute for poverty reduction via increased income and food security. It is widely grown by smallholder farmers and has increased in popularity. Its production among other vegetables has been rapidly expanded into large-scale cultivation during the past decade. It has high productivity and its demand is increasing. Ethiopia produced about 27,774.54 tonnes of tomatoes on 5,235.19 ha annually in 2017/2018. Average national yields are only 5.3 tonnes ha^{-1} (CSA, 2017/2018) while farmers in east Shoa Zone of Oromia produced about 16 to 34 tonnes per hectare under irrigated condition (Putter *et al*., 2012), which is below the world average yields of 37 tons per hectare (FAOSTAT, 2017). Despite the current low average productivity, higher yields up to 50 tonnes per hectare are reported for model farmers in east Shoa Zone of Oromia (Brasesco *et al*., 2019).

Hence, tomato production is an important part of the livelihood of rural communities, which is becoming one of the major hubs of rapid economic growth in Ethiopia (Brasesco *et al*., 2019). Nevertheless, in Ethiopia, soil degradation and nutrient depletion as a result of inadequate soil management is among constraining factors contributing to low agricultural productivity. Tomato production under irrigation in east Shoa Zone of Oromia is among the most intensive production system in terms of fertilizer use per unit area. An assessment study result of farmers' fertilizer use in the Central Rift Valley showed that over 36% of tomato growing farmers used at least 184 kg ha^{-1} N (Edossa *et al*., 2013). Similarly, farmers' input use monitoring study in Adami Tulu Jido Kombolcha (ATJK) and Dugda districts of east Shoa Zone of Oromia revealed that about 155 kg ha^{-1} N is the average application rates for tomato production (Putter *et al*., 2012). The study result in Central Rift Valley of Ethiopia for phosphorus fertilizer use reported that less than 60 kg ha^{-1} P.

In spite of adequate application of NP fertilizer, normal growth of high yielding varieties could not be obtained due to shortage of micronutrients. High fertilizer responsive varieties express their full yield potential when trace elements are applied along with NPK fertilizers (Nataraja *et al*., 2006). Awar and Karami, (2016) also stated that micronutrients like zinc (Zn) and boron (B) significantly increased the crop yield over control when applied single or in combination with each other. Considering the aforementioned facts, it is felt necessary to study the factors responsible for tomato yield improvement.

In line with this, agreement was made between Ethiopian Institute of Agricultural Research (EIAR) and the Victus Trading Plc in December, 2017 in order to test the company's product, namely Tradecorp AZ bentley plus fertilizer on the response of Tomato. Tradecorp AZ bentley plus is a micro granulated fertilizer

that contains B (1.4 %), Cu (1 %), Fe (6 %), Mn (1 %), Mo (0.2 %), Zn (1.4 %) and Co (0.015 %). The product is chemical mix of essential micronutrients chelated with EDTA presented in the form of soluble micro-granules (WG) and enriched with active L-α-amino acids; indicated for preventing and correcting multiple micronutrient deficiencies (https://www.tradeagro.rs). Therefore, this study was initiated to evaluate the efficacy of Tradecorp AZ Bentley plus as a supplementary fertilizer to improve yield of tomato, to evaluate the effects of the product on tomato fruits quality and to determine economical feasibility of the product under irrigation in different sites in east Shoa Zone of Oromia, Ethiopia.

Material and Methods

Description of the study area

The experiment was conducted under irrigation at three locations (Melkassa on station, Meki on farm and Koka at Ethio-Vegfru PLC farm) during 2017/18 and 2018/19 cropping seasons in East Shoa Zone of Oromia, Ethiopia. Geographically the study sites at Melkassa, Meki and Koka are located at 8^{o} 24'59.20" N latitude and 39^{o} 19'15.19" E with an altitude of 1557 meters above sea level (masl); 1635 masl, 9^{o} 17'53" N and 40^{o} 09'46" E; 0^{o}25'07.25" N latitude, 39^{o} 02'29.25" E longitude, 1605 masl, respectively. The soil type of all experimental sites is well drained loam soil, genetically classified as Andosols (Abayneh *et al.,* 2005). Chemical properties of the experimental soil were determined before planting (Table 1).

Table 1. Soil chemical characteristics of the trial sites before application of treatments

Location	PH	Available P (ppm)	TN (%)	OC (%)	Textural class
Koka	6.75	4.12	0.11	4.10	Sandy loam
Meki	6.88	4.92	0.11	4.08	Sandy loam
Melkassa	7.52	8.24	0.041	3.06	Loam

Experimental design and treatment setup

The experiment consisted of five treatments laid out in randomized complete block design (RCBD) with four replications (Table 2). The test crop, tomato (Galilea var.), which has 80-90 days maturity period, was planted under furrow irrigation. The experimental plot size was 5 m*4 m with inter-row and between plant spacing of 1m and 0.3 m, respectively. The spacing between blocks and plots of the experiments were 5 m and 4 m, respectively. The net harvestable plot size was 12 m^2 (3 m*4 m) comprising 3 harvestable rows, each row containing 13 plants. The NPS blend fertilizer, applied at transplanting, was used as source of N, P and S while urea fertilizer was applied in two equal splits, the first half at about 30 days after transplanting and the second half at flowering stage of the crop.

Tradecorp AZ Bentley plus liquid fertilizer product containing soluble micro-granule mix was measured and mixed into 400 lit water per ha basis for soil spray near stem. Each Tradecorp fertilizer rates were split into four round applications. The spray was made every 15 days starting from 2-3 weeks after transplanting till before the flowering of the last cluster of the tomato cycle. The recommended agronomic practices for tomato were uniformly applied to all plots.

Table 2. Treatments setup and nutrient composition of the Tradecorp AZ Bentley plus fertilizer product used in the experiment

Treatments	Macro nutrients (kg/ha)			Micro nutrients (g/ha)						
	N	P	S	B	Cu	Fe	Mn	Mo	Zn	Co
1. Control (no fertilizer input)	0	0	0	0	0	0	0	0	0	0
2. RF (128N, 40 P, 17 S kg/ha)	128	40	17	0	0	0	0	0	0	0
3. RF + 1.8 kg product	128	40	17	25.2	18	108	18	3.6	25.2	0.027
4. RF + 3.0 kg product	128	40	17	42.0	30	180	30	6.0	42.0	0.045
5. RF + 4.2 kg product	128	40	17	58.8	42	252	42	8.4	58.8	0.063

NB: RF= Recommended fertilizer rate

Data collection and measurement

Yield and quality parameters

The tomato fruit yield was collected from the internal rows leaving a row on each side. At each harvest, fruits were graded to marketable and unmarketable yield following the established procedure for tomato crop at Melkassa Agricultural Research Center. Bruised, insect bitten, small-sized (2.5-3.5 cm in diameter), physiologically disordered and sun burnt fruits were considered as unmarketable, while fruits free from visible damages and having diameter greater than about 3.5 cm were considered as marketable. Tomato fruit quality including total soluble sugar (TSS) and pH were also determined.

Agronomic data collection and analysis

The crop data combined over years and locations were subjected to the analysis of variance (ANOVA) using SAS (9.1) software computer package (SAS Institute, 2012) and significance difference among the treatment means were computed with LSD at 5% probability level

Economic data collection and analysis

Partial budget analysis was performed to investigate the economic feasibility of the various alternative treatments (CIMMYT, 1988). The average marketable tomato fruit yield was adjusted 10% downwards to reflect the difference between the experimental yield and the yield farmers will expect from the same treatment. Two years (2017/18-2018/19) average farm gate price (7.00 ETB kg^{-1}) for tomato fruit based on the information obtained from bureau of agriculture office was used for analysis. The farm gate market prices of fertilizers according to bureau of

agriculture office of respective districts (2017/18-2018/19) for Urea (14.00 ETB kg^{-1}) and NPS (15.00 ETB kg^{-1}) were used. For the Tradecorp AZ Bentley plus fertilizer product price (280 ETB kg^{-1}) given by Victus Trading PLC, (VIC/0114/2019) was used. Only production costs that are varying due to the alternative treatments (varying fertilizer and related labor costs) were considered and were estimated based on market prices of fertilizer and daily labor costs that farmers use in the management of their fields.

Gross return (yield * price) and net return (gross return-total varying cost) were calculated to carry out marginal rate of return (MRR) analysis which is important for correct comparison of alternative treatments. In this study, MRR analysis was carried out for non-dominated treatments in a stepwise manner, starting from control to the other treatments (CIMMYT, 1988). A treatment was considered worth to farmers when it's minimum acceptable rate of return (MAR) is 100% (CIMMYT, 1988).

Result and Discussion

Crop yield response

Analysis of variance over years and locations indicated that significant differences were observed for marketable and total yield of tomato across years, locations and treatments applied.

On average higher marketable yield of tomato was recorded from the treatment applied with recommended NPS fertilizer (93.25 ton/ha) from Koka site during the 2018/19 cropping season but at par with the plot applied with recommended NPS + 1.8 kg/ha of Tradecorp AZ Bentley plus fertilizer product from Koka site in the same year and recommended NPS + 1.8 kg/ha of Tradecorp AZ Bentley plus fertilizer product from Meki site in 2017/18 cropping season (Table 3). However, the lowest marketable yield (15.52 ton/ha) of tomato was recorded from the control treatment (no input applied) in 2017/18 cropping season at Koka site but not-significantly different with the one applied with recommended NPS alone at Koka site in 2017/18. Relatively higher total fruit yields of tomato were recorded from Koka site in 2018/19 cropping season and at Meki site during 2017/18 cropping season. However, on average the minimum total yield of tomato were recorded from Koka site in 2017/18 cropping season and both years at Melkassa site (Table 3).

Table 3. Means of tomato fruit yield as affected by treatment application over years and locations

Treatments	Marketable yield					
	Melkassa		Koka		Meki	
	2017/18	2018/19	2017/18	2018/19	2017/18	2018/19
Control (no input)	42.25^{klm}	43.65^{jklm}	15.52^{o}	68.70^{def}	41.10^{lm}	39.26^{m}
RF (128N, 40 P, 17 S kg/ha)	42.25^{klm}	52.56^{hi}	22.463^{no}	93.25^{a}	73.05^{de}	53.78^{ghi}
RF + 1.8 kg of the product	42.91^{klm}	51.55^{hij}	28.95^{n}	89.43^{ab}	86.59^{ab}	61.64^{fg}
RF + 3 kg of the product	56.02^{gh}	48.83^{hijkl}	25.145^{n}	84.41^{b}	67.78^{def}	64.83^{ef}
RF + 4.2 kg of the product	49.95^{hijk}	46.00^{ijklm}	28.47^{n}	81.85^{bc}	75.69^{cd}	70.60^{de}
Mean	54.95					
CV	11.67					
LSD	8.63					
Treatments	Total yield					
	Melkassa		Koka		Meki	
Control (no input)	57.43^{hijk}	51.80^{jklm}	26.88^{o}	83.04^{cd}	48.21^{klmn}	42.33^{mn}
RF (128N, 40 P, 17 S kg/ha)	63.98^{gh}	62.48^{ghi}	39.93^{n}	109.52^{a}	83.7^{cd}	58.38^{hij}
RF + 1.8 kg of the product	63.07^{ghi}	61.88g^{hi}	46.05l^{mn}	103.98^{ab}	99.74^{ab}	64.99^{gh}
RF + 3 kg of the product	75.11^{def}	57.39^{hijk}	43.15^{mn}	100.15^{ab}	78.89^{cde}	68.42^{fg}
RF + 4.2 kg of the product	71.02^{efg}	53.71^{ikjl}	46.71^{lmn}	98.73^{b}	86.28^{c}	75.59^{def}
Mean	64.42					
CV	10.39					
LSD	9.85					

Where = RF - Recommended fertilizer rate, LSD- least significant difference; CV- coefficient variation; Means followed by similar letters are non-significantly different across the rows and columns,

On average application of recommended NPS nutrient rate in combination with 1.8 kg/ha Tradecorp AZ Bentley plus fertilizer resulted in 28.03 % (13.19 ton/ha) and 7.03% (3.95 ton/ha) tomato marketable yield increment over the control (no input) and recommended NPS fertilizer alone, respectively. Increased marketable yield due to the Tradecorp AZ Bentley plus fertilizer which mainly contains micronutrients may be attributed to enhanced photosynthetic activity, resulting into the increased production and accumulation of carbohydrate and favorable effect on vegetative growth and retention of flower and fruits. The role of boron, which enhances the movement of sugar complex from the leaves to the fruit and ultimately increased the fruit yield, is also important (Singh *et al*. 2003). Minimum number of marketable and total yield of tomato in control might be due to non-availability of macro and micronutrients during its development stage in this study. Similar findings were also reported by Saravaiya *et al*., (2014) in tomato.

Accordingly, the effects of treatments and years on the marketable, unmarketable and total yields of tomato were highly significant. However, for the main effect of year on marketable yield at Melkassa and unmarketable yield at Koka, and the main effect of treatments on unmarketable yields at Melkassa and Koka were not significant (Table 4). Year by location also showed non-significant effect on unmarketable yield of tomato in all locations.

Table 4. ANOVA for the tomato yield parameters as affected by treatments applied over years for each location

Melkassa					
Parameters (t/ha)	Sources of variation				
	Rep	Year	TRT	Y*TRT	Error
Marketable yield	127.85	33.94^{ns}	90.36*	116.66*	33.42
Unmarketable yield	22.34	1105.76***	20.67^{ns}	11.22^{ns}	9.98
Total yield	102.8	751.69**	148.46*	136.59*	46.29
Koka					
Marketable yield	47.81	35305.58***	370.01***	102.9**	13.53
Unmarketable yield	40.59	7.67ns	27.81 ns	9.96 ns	19.38
Total yield	58.57	34271.65***	567.48***	86.49*	28.79
Meki					
Marketable yield	95.4	1170.94***	1514.8***	223.11**	49.35
Unmarketable yield	12.04	436.33***	12.24*	9.46ns	4.35
Total yield	107.88	3036.66***	1792.96***	294.9*	59.81

The data given in Table 4 indicated that different doses of Tradecorp in combination with NPS fertilizer had significant effect on marketable and total yield of tomato in the three locations when analyzed separately over years. Among various treatments, the highest marketable yield of 52.42 t ha^{-1}) and total yield of 66.25 t ha^{-1}) recorded from the application of the new product at the rate of 3 kg ha^{-1} with the recommended NPS mineral fertilizers at Melkassa were statistically superior compared to the same yields (42.94 and 54.61 t ha^{-1}, respectively) recorded from the control treatment (Table 5). Application of the recommended NPS fertilizer alone and in combination with the new product at the rate of 1.8 and 4.2 kg ha^{-1} also gave equivalent total yield of tomato to the aforementioned treatment. However, these treatments did not result in statistically significantly different marketable yield (42.95 t ha^{-1}) compared to the control (Table 5). The highest unmarketable yield of 15.82 t ha^{-1} was recorded at Melkassa from the application of the recommended NPS mineral fertilizers alone followed by the yield of 15.24 t ha^{-1} achieved from the combined application of the recommended NPS fertilizer and the new product at a rate of 1.8 kg ha^{-1}, which were significantly different from the yield (11.66 t ha^{-1}) of the control treatment.

At Koka, application of mineral fertilizer alone or combined with the new product resulted in statistically significantly higher total yield of tomato compared to the control treatment (Table 5). The highest marketable yield of 59.19 t ha^{-1} at Koka was obtained from the application of the recommended NPS mineral fertilizers combined with 1.8 kg ha^{-1} of the new product, followed by the yield (57.86 t ha^{-1}) due to application of the recommended NPS mineral fertilizer alone (Table 5). The highest unmarketable yield of tomato (17.56 t ha^{-1}) at Koka, which was superior to the yield (12.85 t ha^{-1}) of the control treatment, was obtained from the application of the new product at the rate of 4.2 kg ha^{-1} integrated with the recommended NPS mineral fertilizer (Table 5).

Overall, analysis of variance over for two years indicated that the highest marketable tomato yield of 63.43 t ha^{-1} was recorded at Meki site followed by the yield of 53.52 t ha^{-1} at Koka site, and the minimum yield of 47.59 t ha^{-1} at Melkassa site (Table 5). The most probable reason why the two sites gave lower yield response to the applied fertilizer compared to Meki could be due to the residual effect of the high rate of fertilizer applied for a long period of time for research and intensive vegetable production. The fertilizer treatments resulted in marketable yield increments of 13.52% (10.39-22.05%), 34.76% (30.09-40.56%) and 72.34% (57.82-82.03 %) for Melkassa, Koka and Meki, respectively, compared to the control treatment (Table 5)

All treatments with the new product integrated with full dose of nutrients from mineral sources gave superior yield compared to the control and recommended NPS applied alone at Meki (Table 5). The highest marketable yield of 74.36 t ha^{-1}, unmarketable yield of 8.25 t ha^{-1} and total tomato yield of 82.36 t ha^{-1} were obtained from the application of the recommended NPS fertilizer integrated with 1.8 kg ha^{-1} of new product. Application of full dose of NPS mineral fertilizer integrated with 4.2 kg ha^{-1} of new product also gave statistically equivalent marketable yield of 73.14 t ha^{-1} and total tomato yield of 80.94 t ha^{-1}. The lowest tomato yields for both parameters were recorded form control, which differs significantly from all other treatments. In addition, application of 1.8 kg ha^{-1} new product in combination with full dose of NPS mineral fertilizer resulted in marketable yield advantages of about 84.47 % and 16.89 %, and 81.93 % and 15.92 % of total tomato yield over the control and recommended NPS fertilizer, respectively (Table 5). The yield improvement could be attributed owing to the application of Tradecorp AZ Bentley plus fertilizer. Awar and Karami, (2016) observed that the combined application of Zn and B exhibited yield increases over the unfertilized control.

Table 5. Means of Marketable yield, unmarketable and total yield of Tomato as affected by treatment application over years at each location separately

Melkassa site Factors	Mark yield (t/ha)	Unmarketable yield (t/ha)	Total yield (t/ha)
Year			
2017/18	46.68[a]	19.45[a]	66.12[a]
2018/19	48.52[a]	8.93[b]	57.45[b]
LSD	NS	2.05	4.42
Treatments			
Control (no input)	42.95[b]	11.66[b]	54.61[b]
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	47.41[ab]	15.82[a]	63.23[a]
Recommended fertilizer + 1.8 kg of the product	47.23[ab]	15.24[a]	62.47[a]
Recommended fertilizer + 3 kg of the product	52.42[a]	13.82[ab]	66.25[a]
Recommended fertilizer + 4.2 kg of the product	47.97[ab]	14.39[ab]	62.37[a]
LSD	5.93	3.24	6.98
Mean	47.59	14.19	61.79
CV	12.5	22.26	11.02
Koka site			
Year			
2017/18	83.53[a]	16.4[a]	40.54[b]
2018/19	24.11[b]	15.56[a]	99.08[a]
LSD	2.39	NS	3.48
Treatments			
Control (no input)	42.11[c]	12.85[b]	54.96[b]
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	57.86[ab]	16.87[ab]	74.73[a]
Recommended fertilizer + 1.8 kg of the product	59.19[a]	15.83[ab]	75.02[a]
Recommended fertilizer + 3 kg of the product	54.78[b]	16.87[ab]	71.65[a]
Recommended fertilizer + 4.2 kg of the product	55.16[b]	17.56[a]	72.72[a]
LSD	3.77	4.52	5.51
Mean	53.52	15.99	69.81
CV	6.84	27.52	7.68
Meki			
Year			
2017/18	68.84[a]	10.53[a]	79.37[a]
2018/19	58.02[b]	3.92[b]	61.94[b]
LSD	4.56	1.35	5.02
Treatments			
Control (no input)	40.18[d]	5.09b	45.27[d]
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	63.41[c]	7.63a	71.05[c]
Recommended fertilizer + 1.8 kg of the product	74.12[a]	8.25a	82.36[a]
Recommended fertilizer + 3 kg of the product	66.31[bc]	7.79a	73.66[bc]
Recommended fertilizer + 4.2 kg of the product	73.14[ab]	7.35a	80.94[ab]
LSD	7.21	2.14	7.93
Mean	63.43	28.86	70.65
CV	11.07	7.22	10.95

Tomato yield can be pushed up by the judicious use of recommended dose of major nutrients along with micronutrients. Boron, copper and zinc also play an important role in enhancing the production of tomato crop by providing resistance against certain diseases becomes imperative in cultivation of tomato crops for increasing the production. Applications of micronutrients using boron, zinc and copper have been reported in increasing yield in tomato (Sivaiah *et al*., 2013). Some micronutrients like Zinc, Iron, Manganese, Copper, Boron and Magnesium have an important role in the physiology of tomato crop and are required for plant activities such as respiration, meristamatic development, chlorophyll formation, photosynthesis, hormone synthesis, gossypol, tannin and phenolic compounds development (Saravaiya *et al*., 2014).

Tomato quality response

The pH and TSS content of fruits were not significantly affected by Tradecorp AZ Bently plus fertilizer application (Table 6). Even though, statistically insignificant, foliar application of nutrients showed slight increases in the content of TSS (Table 6). Among the treatments, highest TSS content (3.9 %) was recorded from application of 3 kg of the product in combination with recommended NP followed by application of 1.8 kg of the product in combination with recommended NP (3.8 %). However, it was lowest (3.4 %) in the control. Similarly, increase in TSS was reported by Saravaiya *et al*., 2014. Awar and Karami, (2016) also reported that application of boron improved the quality of tomato fruit as well as growth and yield. Conversely, fruit juice pH was not affected by foliar sprays of micronutrients (Table 6).

Table 6: Effects of different treatments on TSS and pH of tomato fruits

Treatments	TSS (%)	pH
Control (no input)	3.4	4.49
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	3.7	4.50
Recommended fertilizer + 1.8 kg of the product	3.8	4.53
Recommended fertilizer + 3 kg of the product	3.6	4.58
Recommended fertilizer + 4.2 kg of the product	3.9	4.50
CV (%)	13.31	1.51
LSD (5 %)	NS	NS

Economic analysis

Partial budget analysis results of alternative treatment applications over the locations and years are summarized (Table 7). The analysis revealed a maximum net benefit for application of 1.8 kg of Tradecorp AZ Bentley plus fertilizer product along with the recommended fertilizer rate. However, the marginal rate of return (MRR %) for combined use 1.8 kg/ha of the product with the recommended fertilizer rate was found almost same as that of using recommended fertilizer rate alone. The dominance analysis showed that higher rate Tradecorp AZ Bentley plus fertilizer product applications (3.0 and 4.2 kg/ha) with recommended fertilizer rate

were cost dominated, provided gross margin that was less than that of the preceding treatment.

The partial budget analyses for each specific site over the two cropping seasons are also summarized in Table 7. For Melkassa site, maximum net benefit was obtained for combined application of 3 kg/ha of the product with the recommended fertilizer rate. However, the MRR value is greater than 100% for the application of recommended fertilizer alone, or application of 3 kg/ha of the product along with the recommended fertilizer rate. Alternative practices or treatments are considered worth to farmers when their minimum acceptable rate of return is 100% or beyond (CIMMYT, 1988). Hence, farmers do have alternative treatments to use depending on the amount of investment they can assign to use the product and expect to gain for the additional investments made. For Koka and Meki sites, the analysis showed maximum net benefit for combined application of 1.8 kg/ha of the product with the recommended fertilizer rate. For farmers at Koka, however the net benefit was high for using 1.8 kg/ha of the product with the recommenced fertilizer rate, the payback for each unit of investment was higher in using the recommended fertilizer rate alone. At Meki, not only the net benefit but also the profit for each unit of financial investment in using 1.8 kg/ha of the product with the recommended fertilizer rate was also high; about 21.39 ETB for 1 ETB investment.

Table 7. Partial budget and dominance analysis of fertilizer products for marketable tomato fruits

Treatments	TCV (ETB/ha)	NB (ETB/ha)	MRR (%)
Analysis over years at Melkassa			
Control (no input)	0.0	270585.0	
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	7127.2	292555.8	308.3
Recommended fertilizer + 3 kg of the product	10567.2	322718.8	876.8
Analysis over years at Koka			
Control (no input)	0.0	265293.0	
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	7127.2	358390.8	1220.6
Recommended fertilizer + 1.8 kg of the product	10231.2	365705.8	280.9
Analysis over years at Meki			
Control (no input)	0.0	253134.0	
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	7127.2	393355.8	1967.4
Recommended fertilizer + 1.8 kg of the product	10231.2	459764.8	2139.5

NB: TVC= total variable cost; NB= net benefit; MRR= marginal rate of return

Conclusion and Recommendation

Tomato is the most grown vegetable crop with high potential to contribute for poverty reduction via increased income and food security. Its production in Ethiopia has rapidly expanded into large-scale cultivation during the past decade. Yet, average yield of tomato in Ethiopia remained low as compared to the world average. Low inherent soil fertility and its depletion are among the contributing factors. Hence, this study was designed to evaluate a combination of recommended NPS fertilizer and Tradecorp AZ Bentley plus fertilizer on tomato yield at different locations of East Shewa Zone under irrigation. The result obtained for three locations over two years indicated that application of Tradecorp AZ Bentley plus fertilizer product improved tomato marketable and total yields at Melakassa and Meki sites. In addition, the partial budget analysis result also showed higher net benefit and acceptable MRR due to application of Tradecorp AZ Bentley plus as supplementary fertilizer in combination with the recommended fertilizer rate at Melkassa and Meki. Hence the product is recommendable for tomato producing farmers in Melkassa and Meki area.

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