Tomato production in Ethiopia: constraints and opportunities

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Tomato is a widely grown vegetable crop in Ethiopia. It is consumed in every household in different modes, but in certain areas, such as Walo, Hararge, Shawa, Jimma and Wallaga, it is also an important co-staple food. Primary data were collected from 400 randomly selected smallholder producers who were equally distributed among five different study zones where tomato was a co-staple. These data were used to describe the actual tomato production management practices and to quantify the distribution of crop area and production in relation to agro-ecological conditions in the different administrative zones (North Walo, East Hararge, East Shawa, Jimma and East Wallaga) and growing seasons. Surveys and Focus Group Discussions (FGDs) were held with growers and staff of the Ministry of Agriculture during 2011. Qualitative and quantitative data were gathered by employing a structured questionnaire. Before launching the survey, the questionnaire was pre-tested and improved. Yield constraints were identified based on the survey including the 400 smallholder producers. The FGDs were used for triangulation. Constraints appeared to include lack of resources such as irrigation water, nutrients and high-quality seed, but also weather conditions including drought and cold. Crop production management varied significantly across study zones because of differences in agro-climatic conditions, access to resources and culture. Average fruit yields ranged from 6.5 to 24.0 Mg ha^{-1} and were different for the five survey zones. According to the survey and FGDs results, about 32-40% of the growers used irrigation. Supplementary irrigation was required in most of the production regions to sustain food security and commercially viable tomato production. There were also several major weeds, insect pests and diseases including late blight and Fusarium wilt reducing the yield. Possibilities for yield improvement are discussed and recommendations are made to further improve tomato yield in the different growing zones.

Key words: Biocides, diseases, Ethiopia, improved seed, irrigation water, nutrients, pests, tomato.

1. Introduction

The introduction of cultivated tomato (*Solanum lycopersicum* Mill.) into Ethiopian agriculture dates back to the period between 1935 and 1940 (Samuel *et al*., 2009). The Ethiopian Institute of Agricultural Research (EIAR) was established in 1966 (Setotaw, 2006; cf. Roseboom *et al*., 1994:2) during which tomato was recognized as a commodity crop. Since 1969, 300 varieties were tested (Shushay, 2011). However, among varieties tested most showed susceptibility to late blight, powdery mildew and mosaic virus (Tindall, 1970). The first record of commercial tomato cultivation is from 1980 with a production area of 80 ha (Lemma, 2006) in the upper Awash by Merti Agroindustry for both domestic as well as export markets. The total area increased to 833 ha by the year 1993 and later on the cultivation spread towards other parts of the country. Since 1994 up to present, tomato acreage increased to 5338 ha with a total production of 55,635 Mg (CSA, 2011). Currently tomato is one of the regional export crops of the country (Wiersinga and de Jager, 2009; Joosten *et al*., 2011). In Ethiopia, the crop is grown between 700 and 2000 m above sea level, with about 700 to over 1400 mm annual rain fall, in different areas and seasons, in different soils, under different weather conditions, but also at different levels of technology (e.g. with furrow, drip or spate irrigation) and yields (Ambecha *et al*., 2006; Birhanu and Ketema, 2010).

Smallholders have grown tomato for long time for their livelihood needs since the start of its commercialization. Yet, average yield of tomato in Ethiopia is low, ranging from 6.5-24.0 Mg ha^{-1} compared with average yields of 51, 41, 36 and 34 Mg ha^{-1} in America, Europe, Asia and the entire world, respectively (FAOSTAT, 2010). Moreover, growers have been challenged by inconsistent production and low yields. Improving smallholders' tomato production would contribute to enhancing food security and alleviating poverty. The few surveys carried out so far on tomato production were broad and covered all horticultural crops. Such surveys were crude and did not identify production status and constraints at the level of the individual crop. Moreover, the limited information available at the crop level is site-specific (Abebe *et al*., 2005; Lemma, 2002) and no attempts have been made to assess for each tomato growing eco-region conditions that may limit or reduce yield.

Thus, we carried out a survey at household farm level by identifying the status, constraints and opportunities of tomato production in the country, to explain the low yield levels in tomato production. In this survey, emphasis has been given to education level of household head, seed type, irrigation, chemical fertilizers, biocides use, diseases, drought and cold effects.

2. Materials and methods

The survey work was undertaken in five selected tomato growing zones of the country to represent different eco-regions and production systems where tomato was a co-staple. Jimma, North Walo, East Shawa, Hararghe, and Wallaga were selected to represent warm humid lowlands to cool humid mid-highlands, cool moist mid-highlands, tepid semi-arid dry land, tepid moist mid-highlands, and warm sub-humid lowlands to tepid sub-humid mid-highlands, respectively, to assess actual crop management practices followed by growers and possible yield constraints.

Primary data were collected from 400 randomly selected smallholder producers who were equally distributed among the five different study zones. Survey and Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were held with growers and staff of the Ministry of Agriculture during 2011. Qualitative and quantitative data were gathered by employing a structured questionnaire. Before launching the survey, questionnaire was pre tested and was improved accordingly. FGDs and KIIs were guided by checklists prepared for the study purpose. The data on area, production and yield were obtained from CSA (CSA, 2001-2010), EIAR at different locations, Ministry of Agriculture at different levels, and experimental stations belonging to each zone (FARC, 2011; SARC, 2011; BARC, 2011; MARC, 2011). These are presented in tables or figures, and when important, differences between sources are discussed. The variables that have been hypothesized as factors more likely influencing tomato yield were fitted to multiple regression analysis to determine the variables constraining tomato yield in the study areas.

The Cobb-Douglas production function, which provides measures of output elasticity was estimated using the Ordinary Least Squares (OLS) method since it estimates real contribution of each and every factor constraining yield. This functional form assumes a unitary elasticity of substitution and a constant elasticity of production for all inputs (Coelli *et al*. 2005).

The yield response model of the sample tomato growers considered inputs of production and other farm-specific characteristics:

$$\mathrm{LN\,Y} = \beta 0 + \beta 1 \mathrm{LN\,edu} + \beta 2 \mathrm{ST} + \beta 3 \mathrm{I} + \beta 4 \mathrm{B} + \beta 5 \mathrm{CF} + \beta 6 \mathrm{DE} + \beta 7 \mathrm{D} + \beta 8 \mathrm{CE} + \mathrm{e}$$

where: LN is natural logarithm Y = yield of tomato (dependent variable in Mg ha^{-1}) for this study; β0 – β8 = constant; edu = level of education; ST = Seed type used (1 = improved seed and 0 = recycled seed); I = irrigation use (1 = user and 0 = otherwise); B = biocide use (1 = user and 0 = otherwise); CF = commercial fertilizer use (1 = user and 0 = otherwise); DE= disease effect (1= affected by disease and 0 = otherwise); D = drought (1= water supply on demand throughout growing period and 0 = otherwise); CE = cold effect (1= cold damage and 0 = otherwise); and e = error term.

3. Results and discussion

Area, production and yield in the selected major tomato growing zones

The cropping area varied from 379-1489 ha in different zones with average fruit yields ranging from 6.5 to 24.0 Mg ha^{-1} (Table 1). The large tomato production comes from the late cycle (November-March), due to the large area cropped during that cycle, whereas highest productivity is from the intermediate late (February-June) cycle followed by the late cycle in

East Shawa zone (Table 1), because of suitable agro-climatic conditions compared with other cycles. During 2001-2010 the area in the sample zones were inconsistently increasing and decreasing. In North Walo (Fig. 1a), area and production increased (2001-2007), but from 2007 onwards the area decreased because of scarcity of irrigation water associated with extended drought for some growers, whereas production increased as a consequence of fertilizers adoption by resource-rich growers (Table 2). In East Hararge (Fig. 1c), there were remarkable increases in area and production (2001-2005) because of good climate and market opportunities. However, in 2006 area and production decreased by 19 and 16%, respectively, as a result of poor access to irrigation water and biocides to control diseases (Table 2). In East Shawa (Fig. 1e), area and production increased by 64 and 70% over the period 2001-2003, but the area declined by 40% in 2004 as a consequence of poor market access during 2003 and shortage of improved seeds (Lemma, 2006). Area and production also decreased by 34 and 27%, respectively, in 2006 because of poor access to credit and fertilizer supply (Own survey, 2011). In 2007, the area (24%) and production (30%) increased as a result of good market opportunities. In East Wallaga (Fig. 1g), area and production increased over the period 2001-2003 as a result of suitable climate and market opportunities, but in 2004 both declined, by 11 and 10%, respectively, because of poor control of late blight. There was a gradual increment in area and production due to poor access to credit and irrigation water and inputs (2005-2008). A decrease of 12 and 9% in area and production, respectively, occurred in 2009 as a consequence of soaring input prices and low product price. In 2010 there was a slight increase in area (5%) and production (6%) as a result of good climate and market. In Jimma (Fig. 1i) area and production increased during the period 2001-2003. However, they decreased by 37 and 36% between 2004 and 2005 because of damage by late blight (Fikre, 2006; JZBoA, 2011). From 2005-2008 increases in area (18%) and in production (20%) were observed as a consequence of access to input. These increases were followed by a decrease in area (2%) and in production (3%) in 2009. In 2010 area and production increased by 5 and 6%, respectively.

According to the results from the KIIs and FGDs, about 32-40% of smallholders use irrigation (entirely furrow). The study also indicates that various socio-technical problems resulting from inappropriate technology and poor irrigation handling might lead to crop failure. The lack of clear water rights de-motivated growers from participating in irrigation activities which in turn affected the yield (Tables 1 and 2). Although the amount of water needed for irrigation depends on farm size, there are various sources of conflicts in inequitable water distribution due to poor scheme coordination, water theft, water shortages and corruption.