Importance of Vegetable Seed Production

Research Review

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ABSTRACT

Vegetable production constrained by shortage of seeds/planting materials, diseases and insect pests, poor postharvest handling and poor linkage to market and market information. This paper intended to review warm season garden vegetable seed production. Ethiopia has diverse agro-ecologies for production of warm season vegetables like tomato, chili and sweet pepper as well as green beans. The high demand for horticultural products, availability of suitable agro-ecology, and increasing irrigation schemes development focusing on vegetable production, have resulted in increased demand for quality seeds of improved varieties of various vegetable crops so as to serve further boost in local production, albeit with increased investment. The increase in import of vegetable seed is attributed to expansion of irrigated vegetable production both for local consumption and export. This implies that there is a substantial demand for vegetable seeds and increase in vegetable production in Ethiopia within the reference period. The development of the vegetable sub-sector is one of the priority areas in the agricultural development strategy of Ethiopia (Ethiopian Investment Agency, 2008; 2012). Commonly grown by small scale farmers and commercial growers both during rainy and off-seasons. Since, there is no organization involved in the multiplication of vegetable seeds, access of these crop varieties is very limited. The demand is rapidly increasing. Several high yielding varieties of vegetables with improved technologies have been developed however availability of quality seed with insufficient quantities is a major constraints. In order to meet this challenge there is need to initial seeds of released varieties are multiplied and maintain annually by understand and document farmers' preference for vegetable, variety/varieties of the preferred type(s), criteria for their preference based on their perceptions; and popularize the improved seed production packages in vegetable crops, which would in turn provide comprehensive knowledge to the seed growers regarding the recent advances in technologies.

Key words: Quality, Seed, Season and Vegetables.

1. INTRODUCTION

Vegetables are defined in culinary terms to include vegetables “proper”, that have fruit and leafy herbaceous parts eaten raw or cooked (lettuce, head cabbage, Ethiopian cabbage/kale, tomatoes, green and red peppers, Swiss chard, celery, green beans, etc.), root and tubers which include beetroot, carrot, potatoes, sweet potatoes, taro/godere and bulb crops (onion, garlic, shallot) (CSA, 2013). Moreover, vegetables serve as raw material for agro-industries (tomato paste-capsicum and oleoresin extraction from chili peppers). Their importance as a source of employment and foreign currency earner is increasing. Vegetables serve as suitable crops for farming systems diversification and land intensification, particularly with recent increases in the establishment of small and medium scale irrigation schemes in the country (Demissie et al., 2009; Baredo, 2012).

In the world of vegetable gardening, there are approximately 50 kinds of delectable, edible plants commonly grown. They can be divided into two broad categories: cool-season vegetables and warm-season vegetables. Cool season vegetables grow best in spring and fall when temperatures are mild, and most can withstand light frosts. Warm season vegetables do best when weather and soils are warm, and can really handle hot weather. There has been a substantive, long-term underinvestment in research and development of the horticultural sector in Africa with particular reference to those traditional crops, which are naturally high in nutritious vitamins and minerals (Afari-Sefa et al., 2012).

Warm season vegetables need eight or more hours of uninterrupted sun to produce a good crop. It requires a great deal of sunlight energy to produce fruit. Most garden vegetables require a soil pH of around 6.5 and organic matter content of 5% or more. It also require warm soil and air temperatures if they are to germinate, grow and mature properly. They will not tolerate any frost and may be severely damaged by prolonged temperatures as much as 15 degrees above freezing. The root systems are deep in the soil and generally quite resistant to drought. However, irrigation may increase yields. Fruiting may, in fact, be delayed by excessive nitrogen fertilization (Gretchen Voyle, 2015).

In Ethiopia, the area under vegetables increased from 350,600 ha with production of 2.36 million tons in 2010 to 396,510 ha with production of 4.48 million tons in 2013 for smallholder farmers (CSA, 2010; 2011; 2012; 2013). This implies that the area cultivated to vegetables increased by 13% while the production increased by 103%, between 2010 and 2013. The area under vegetable production and the quantity produced by medium and large scale commercial state and private farms also showed an increasing trend during the reference period. Similarly, export of vegetables increased from 37,210 tons valued at USD163.86 million in 2003 to 220,210 tons valued at USD 437.5 million in 2013 (Ethiopian Revenue and Customs Authority, 2013), representing 709% increase in export volume and 167% in revenue.

Ethiopia follows Organization for Economic Cooperation and Development's (OECD) regard to seed production, which had four seed generation system breeder seed, pre-basic, basic and certified seed. Research centers largely responsible for the first early three generations, while the public seed enterprises, private and cooperative/unions are producing certified seed and also NGOs and seed development programs are also involved in community based seed production. As noted below most of vegetable seeds are imported by licensed agro-chemical importers/traders (Amsalu Ayana, *et al*, 2014). More recently, seeds were often obtained from local agricultural retailers. For many years, farmers saved their own vegetable seeds and maintained their own cultivars. Today, vegetable growers are faced with a wide array of seed treatments and cultivars that may be purchased from sources around the world. Using quality seeds is a prerequisite for successful vegetable production; vegetable seeds are still a rather small investment compared to other production costs. Like other agriculture crop production, vegetable seed handling practices, processing, and production have changed less emphasis over the years. Finally this paper intended to review recommend future strategies for a viable vegetable seed production and distribution.

2. RESEARCH RESULT

Ethiopia is endowed with diverse agro-ecologies suitable for the production of different categories of vegetables. Tropical, sub-tropical and temperate vegetables are produced in the

lowlands (<1500 meters above sea level), midlands (1500-2200 masl), and highlands (>2200 masl), respectively (FAO, 1984; EHDA, 2011; EHDA, 2012).

Nutritional and health value of vegetables is also well recognized in Ethiopia because vegetables play important roles in human health by way of providing antioxidants such as vitamin A, C and E that are important in neutralizing free radicals (oxidants) known to cause cancer, cataracts, heart disease, hypertension, stroke and diabetes (Demissie et al., 2009; Tabor and Yesuf, 2012). Vegetables constitute also source of cash income for the households and an opportunity to increase smallholder farmers' participation in the market (Alemayehu et al., 2010). Vegetables are also used as source of raw material for local processing industry. Products like tomato paste, tomato juice, and oleoresin and ground spice of Capsicum are produced for exports making a significant contribution to the national economy (Aklilu, 1997; Baredo, 2013). The increasing development of the horticulture industry and the intensive production practices of horticultural crops are creating employment opportunity, especially for women and youth (Ethiopian Investment Agency, 2012).

2.1.Principles of vegetable seed production

Isolation Distance: For successful hybrid seed production the field must be isolated from other varieties of the same crop, cultivated species and their wild relatives if any to make sure the production of genetically pure seeds. Many of these crops are highly cross pollinated; hence isolation distance for both foundation and certified seed production should be maintained as per the seed production standard. The isolation distance between cross compatible varieties can be achieved by the following ways (Tomar, et al, 2017).

1. Time isolation: It will allow the seed production of different varieties of the same crop at the same place each year. If the season is too long enough to allow two production cycles of the cross compatible crops then they are isolated by time. For example, early and mid-maturity group of cauliflower grown for seed production can be isolated by time.

2. Distance isolation: The isolation distance for self-pollinated varieties is comparatively less but, for cross-pollinated varieties the isolation distance from other variety should be relatively more. The isolation distance also varies with the direction of insect flight (in case of insect pollinated varieties) or the direction of winds (in case of wind-pollinated varieties).

Selection of suitable season and areas for seed production: For seed production the crop should be grown in areas where dry seasons prevail at the time of seed maturity and extraction. The locations are also important in seed production to enhance seed yield with better quality (Tomar, et al, 2017).

Rouging: is the removal of individual plant which do not confirm to the distinct limits of a particular variety. Therefore, rouging is a technique that is used in seed production to maintain genetic purity of the variety. The off-types may occur in a crop due to a variety of the morphological types within a crop. The cross-pollinated vegetable crops like Cole crops, Cucurbits and Onion) shows high morphological diversity than self-pollinated) crops (e.g. Peas, Tomato, Fenugreek). Therefore, the varieties of self-pollinated crops are generally more uniform and stable than varieties of cross pollinated crops (Tomar, et al, 2017).

Different stages of rouging:

1. **Before flowering:** On the basis of vegetative characters (plant growth, foliage morphology, color etc.) the off-types are removed from seed production field.
2. **At flowering:** The early and late varieties can be easily identified on the basis of curd maturity and sex expression in cauliflower and cucurbits respectively, and flower initiation time in solanaceous crops.
3. **At fruit development:** Trueness to type of developing fruit (Fruit shape, size, color, color of ripen fruit (green, yellow, red) is checked and on the basis off -type plants are rouged out.
4. **At maturity:** The plants showing late maturity of fruits in the early variety and vice versa should be removed immediately from seed production field.

Threshing and seed extraction: It varies from crop to crop. Threshing can be done by hand or machines. Threshing machines should be properly cleaned to avoid admixture. Generally, seeds should be extracted from dry fruits or from fruits in which the seeds are wet at the time of extraction.

Seed Standards: It refer to the field inspection of the harvested produce as well as the manner of harvesting, transporting, processing and packing. Unless, a seed certification agency keeps track of harvested produce until it is packed and sealed the identity of the lots cannot be assured.

Seed certification agency should lay down standard for processing plants. In addition, field and seed standards, such as isolation distances, inseparable other crop seeds, weeds, plants affected

by seed borne diseases, genetic purity, percentage of pure seed, other crop and weed seeds, inert matter, moisture content, germination and insect damage, should be prescribed for successful accomplishment of the certification (Tomar, et al, 2017).

Major advantages of warm season vegetables seed production under protected conditions are:

1. Higher seed yield (generally 2-4 times more) and seed quality as compared to open field
2. Requirement of isolation distance in cross pollinated vegetables can be minimized.
3. Problem of synchronization of flowering can be minimized.
4. Maximum plant population can be maintained.
5. Seed production under adverse climatic conditions is possible.
6. Training, pruning and hand pollination practices are very easily manageable under protected conditions compared with to field seed crop.
7. Seed crops will not be damaged by un-seasonal rains at the time of their maturity.
9. Seed viability and seed vigor could be extended through better nutrient management in seed crops under protected conditions.

2.2. Vegetable Seed extraction methods

There are two methods of seed extraction in vegetable crops.

Dry Method: The fully matured and dried fruits are harvested and kept under sun light for 2-3 days. After removal of seeds, these are dried under sun light between 8.00-11.00 Am and 2.00-5.00 PM to reduce the high moisture content. The seeds of Chili, Okra, Sponge gourd and Ridge gourd etc are extracted by dry method. The seeds of Radish are harvested when pods become brown and parchment like when the seeds are near maturity (Tomar et al., 2016). The harvesting of carrot umbels should be done where the secondary umbel is fully ripe and third under umbels have started to turn brown. For high quality seed, primary and secondary umbels should harvest and rest should be avoided (Tomar et al., 2016).

Wet Method: This method is used for seeds extraction of tomato, brinjal, cucumber, muskmelon, watermelon, ash gourd, bitter gourd, round melon and long melon. There are two methods of seed extraction under wet method:

i) Acid Method: The fully ripened matured fruits are harvested and crushed along with pulp. The pulp is taken in plastic container or wooden container and the commercial HCL added. The

acid and pulp are mixed thoroughly and kept for some time. The corrosiveness of the acid removes the mucilage adhering to the seed and makes the seed free of pulp. The seeds are washed 4-5 times thoroughly with water to make free of acid. The seed extraction is quicker in this method. Seed are also bright in color with good germination ability and free from fungal attack.

ii) Fermentation Method: The fruits are crushed in a non-metallic container and kept as such for fermentation for 2-3 days. During fermentation the seeds get detached from the adhering pulp and settles to the bottom of the container. The seeds are separated, washed thoroughly and dried under shade to the desired moisture level. The seeds become dull color due to fermentation of the pulp and also due to the fungal load in the seeds

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iii) Alkali Method: Fully ripened matured fruits are harvested and crushed to make pulp. In Tomato, to hasten the fermentation process 0.5% sodium bicarbonate (500 g dissolved in 10 lit. of warm water is added to the pulp and allowed to remain for a day. Then, the seeds are separated and washed free of alkali with water.

2.3 Planting Options

Planting of vegetable seeds for seed production is generally done by direct seeding or transplanting of glasshouse grown seedlings. Biennial vegetable seed production, however, can be achieved using two planting techniques. The "seed-to-seed" method is done by planting biennial seed, allowing the resulting plant to overwinter without being transplanted, and harvesting the seed crop the following season. This method does not permit the selection or rouging of root or other genotypic characters. A majority of carrot and onion seed crops are produced by this method which is less expensive and complex than the "root-to-seed" method (Welbaum**,** 2005).

Seeds or transplants

Seeds are more affordable and provide an opportunity for children to follow the entire plant life cycle, but they require more attentive watering immediately after planting to be successful.

With transplants**,** these small plants have usually been started indoors about eight weeks before they are going into the garden. This extends their production time in the garden because they are older. During transplants, choose those without flowers or fruit. Plants in starter trays that have set flowers or fruit will not be as productive as those without. Plants such as tomatoes grown in large containers that have set some fruits are less likely to be affected by this stress. Picking off flowers or fruit will not reverse the plant to green growth (Welbaum**,** 2005).

The "root-to-seed" method is done by planting biennial seed, removing the resulting plant (e.g., root) from the soil (in some cases stored), replanting, and harvesting the seed crop the following season. The replanted plant is referred to as a "stickling." This method permits the selection or rouging of root or other genotypic characters. It also decreases the time required for cultivar development (Welbaum**,** 2005).

Vegetable seed production also is unique from most agronomic crops because vegetables such as beets, carrots, and cabbage are biennials and must develop sufficient vegetative growth prior to cool temperature exposure in order that vernalization successfully induces flower formation the following season. Planting such crops too early causes' winter kill or late season pest infestations. Planting too late results in a lack of vernalization which limits flowering and reduces seed yield. In some instances, vegetable seed producers opt not to start the seed crop by seed. Rather, to ensure optimum vegetative growth for vernalization, they plant some developed portion of the vegetative structure. This is commonly done with carrot and beet stickling and onion bulbs which allows for maximum production of plant biomass before vernalization (Welbaum Greg**,** 2005).

Vegetable seeds also vary greatly in their tolerance to soil temperatures at planting. Pea, radish, and spinach require cool soil temperatures for optimum seedling emergence. Beets, cabbage, carrot, and onion are tolerant of cool soil temperatures although they do better in warmer soils. Squash and melons require warm soil temperatures for optimum seedling emergence. In regions with high summer temperatures, vegetables such as tomato, pepper, eggplant, and cucurbits are planted in the early spring to optimize flowering and seed set in early summer. Later plantings of these seed crops are possible by transplanting young plants previously started in glass houses.

This avoids the delayed establishment of plants from direct seedlings due to cooler night temperatures and wetter soils encountered in the early spring (Welbaum Greg, 2005).

Row spacing and planting densities of vegetable seed crops differ from those for fresh market production. Sufficient space for flower development, air movement to reduce pathogens, unrestricted access to inflorescences by pollinators, mechanical cultivation, and harvest operations are necessary for seed crops. In some cases (e.g., eggplant, pepper, tomato, muskmelon, watermelon), row spacing used for seed production are the same as those for fresh market production. In most cases, row spacing is different for vegetable seed production. In lettuce, the size of the head will be larger than the fresh market head in order that bolting is promoted. Large-head types are planted 25 to 30 cm apart while small-head and loose-leaf types are planted 15 to 20 cm apart. Similar considerations are encountered for cabbage (Welbaum Greg**,** 2005).

Insect pollinated vegetables include most of the Cole crops, carrot, and onion. Row spacing's and planting densities are also important considerations in the production of vegetable seed hybrids. In order to maximize the amount of hybrid seed produced, the optimum ratio of female to male rows must be determined **(**Welbaum Greg**,** 2005).

Transplants purchased from a local nursery or home improvement store still require regular watering and attention, but are not as sensitive and are more likely to thrive. With transplants**,** these small plants have usually been started indoors about eight weeks before they are going into the garden. This extends their production time in the garden because they are older. When buying the planting materials (transplants), choose those without flowers or fruit. Plants in starter trays that have set flowers or fruit will not be as productive as that with-out. Plants such as tomatoes grown in large containers that have set some fruits are less likely to be affected by this stress. Picking off flowers or fruit will not reverse the plant to green growth.

Policy and institutions: Presence of favorable agricultural development policy and strategies supporting the development of the horticulture sector, including vegetable production, processing and marketing locally and for export. The prevailing conducive policy, suitable agro-climatic conditions, presence of a number of supporting institutions and increasingly improving infrastructure development such as small to medium scale irrigation schemes, road and

communication networks, expansion of urbanization, and increasing awareness of the importance of vegetables for health and nutrition constitute the potentials for integrating and expanding vegetable production in the Ethiopian Agricultural System (Bezabih E., et al., 2014).

3. CONCLUSIONS AND RECOMMENDATIONS

Vegetables are an integral part of human diet and known as protective foods, which contribute required minerals, vitamins and other nutrients of medicinal and therapeutic values. Moreover, vegetables serve as raw material for agro-industries (tomato paste-capsicum and oleoresin extraction from chili peppers). Their importance as a source of employment and foreign currency earner is increasing. Vegetables serve as suitable crops for farming systems diversification and land intensification, particularly with recent increases in the establishment of small and medium scale irrigation schemes in the country (Demissie et al., 2009; Baredo, 2012). Among the production constraints, lack of improved varieties with disease and insect pest tolerant are the primary issues.There is a general increasing trend for development of the horticultural sub-sector partly due to increasing demand emanating from increasing population, urbanization, increased awareness of the nutritional and health importance of horticultural crops like vegetables. This has triggered increased demand for good quality seed this issue prevailing with conducive policy, suitable agro-climatic conditions, presence of a number of supporting institutions and increasingly improving infrastructure development.

The most important and feasible approach to enhance the productivity of vegetable crops would be the production of quality seed and making it available. The importance of good quality seed can hardly be over emphasized as it is crucial for high productivity (BPD manual 2009/1). Several high yielding varieties of vegetables with improved technologies have been developed but availability of quality seed insufficient quantities is a major constraints. In order to meet this challenge there is need to popularize the improved seed production packages in vegetable crops, which would in turn provide comprehensive knowledge to the seed growers regarding the recent advances in technologies. Local seed management practices, such as seed selection, cleaning, treatment, or separate storage and also other agronomic practice ensure to improve or maintain seed quality, productivity and farmers preference finally increase productive land.

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