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Current status of tomato greenhouse production in Khartoum and Gezira States, Sudan.

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ABSTRACT

Tomato production under protected cultivation has increased consistently in recent decades in the Sudan. The objective of this study was to investigate the current situation of tomato cultural practices in existing greenhouses in Khartoum and Gezira States. A survey was carried out using a questionnaire and interviews with greenhouse owners in Khartoum and Gezira States. Khartoum and Gezira States have about 68 greenhouse projects, 33 of them were selected for the study. Data were collected during 2013 and analyzed using statistical package for social sciences (SPSS). Results indicated that a large number of introduced tomato cultivars were used for production and most of greenhouse farmers (48.5%) sow tomato seeds in mid-February. The majority of farmers (63.6%) grow tomato in high plant density (30cm). More than half of greenhouses (75.8 %) had no specific fertilizer programs. Most of the greenhouse farmers (90.9 %) prune weekly. All greenhouse farmers used pesticides for pest control. Our observations indicated that most of the growers failed to produce summer tomato. Accordingly, further research in tomato greenhouse production is needed.

INTRODUCTION

Greenhouse technologies enable the cultivation of crops in a controlled environment, regardless of the external environment. Vegetable greenhouse production is currently used commercially for the production of a wide range of vegetables including tomato, cucumber, bell pepper , melons and other crops ((Pardossiet *et al,* 2004 and Tuzell,2013) .In the Sudan, the most important vegetables produced under greenhouse conditions are cucumber and tomato. Field tomato production in the Sudan is currently limited by the hot summer conditions and the incidence of a large number of pests and diseases. Production of off-season tomato can be achieved by using properly designed greenhouses to suit the hot arid conditions of the Sudan. In addition, a wide range of cultural practices need to be modified to suit tomato greenhouse production, with the objective of optimizing production and maximizing economic returns. These cultural practices include choice of cultivars, age of tomato transplants, optimum spacing, irrigation, fertilizer use and pests and disease control Young seedlings have proved to be better than old ones with respect to vegetative growth and total yield (Vavrina, 1998). Knowledge of the optimum spacing in greenhouse enhances production by increasing yields and possibly improving quality of tomatoes (Kirimi *et al*, 2011). Soil tests complemented with plant tissue analysis are needed for a most efficient fertilizer management program. Trace elements, such as zinc, manganese and copper are increasingly recognized as essential when aiming for better yields (Gupta, 2005).An integrated approach to insects and disease management which involves the use of resistant cultivars; sanitation, sound cultural practices and proper use of the correct pesticides,**(**Marwan, 2013).must be used for pest and disease control,(Abdelhaq, 2013**)**.The objective of this study was to investigate the current situation of tomato cultural practices in existing greenhouses in Khartoum and Gezira States, Sudan.

MATER IALS AND METHODS

A survey was conducted in Khartoum and Gezira States to investigate the cultural practices of tomato in existing greenhouses. Khartoum State is located between latitude 15° 14′ and 16° 38′ N and longitudes 31° 34′ and 34° 21E′. Gezira State is located between latitude 13°36′ and 15° 16′ N and longitudes 32° 26′ and 34° 18′ E. All greenhouse projects in Khartoum and Gezira States were considered as the population of the study. The total number of greenhouse projects in Khartoum and Gezira States was 68, 33 of them were selected for the study. A questionnaire was designed for provision of information needed. The personal interview technique was used to administer the questionnaire Data collection included cultural practices (sowing date, age of transplants, plant density, fertilization, pruning interval, pest and disease control and tomato yield). Data were collected during 2013 and analyzed using statistical package for social sciences (SPSS) to calculate frequency distribution and percentage for descriptive analysis.

RESULTS AND DISCUSSION

Sowing date of tomatoes

Results revealed that 48.5% of farmers sow tomato seeds in mid-February, 42.4% sow seeds in end- March and 9.1% in mid-March (Table1). Under Sudan conditions off-season tomato production in greenhouses fetches high prices and is very profitable. Production is generally seasonal with two peaks; early summer and a second in autumn. Martin, (2003) reported that the best yields were achieved when seeds were sown in late January and transplanted into the greenhouse in early March and tomatoes commenced to ripen in late May. The current trend is to lengthen the crop cycle, despite some undesirable consequences on plant performance, quality and harvesting time. Although there are advantages in extending the cropping season, yet it is necessary to take into account that the harvesting times of crops produced in the open field and in greenhouses will overlap and the products will compete in the same market (La Malfa and Leonardi, 2001).

Table.1. Distribution of greenhouses according to sowing date.

Month	Frequency	%
Mid-February	16	48.5
Mid-March	03	09.1
End –March	14	42.4
Total	33	100

Age of transplants

Distribution of greenhouses according to age of tomato transplants is shown in Table 2. Results indicated that 39.4% of farmer transplant tomato seedlings at the age of 30 days and the same percentage (30.3%) transplant at 35 and 40 days old. Direct seeding of tomatoes is not used in tomato greenhouse production due to the high cost of hybrid seed and the specific conditions required for adequate germination. Direct seeding has other disadvantages; (1) Weed control is usually much more difficult with direct seeded than with transplanted tomatoes; (2) Direct seeding requires especially well made seedbeds and controlled depth of planting and in-row spacing. (3) Because of the shallow planting depth required for tomato seed, the seed bed must be leveled to prevent seeds from being washed away or covered too deeply with water-transported soil (William and George, 2004).Transplanting tomato seedlings at an early age showed vigorous vegetative growth and *vice versa* (Vavrina, 1998). In some countries, tomato transplant age of 3–5 weeks old is considered ideal, while transplants age over 5 weeks old is less desirable (Peet and Welles, 2005). Age of transplants strongly influences subsequent growth and yield in the greenhouse. Used of properly selected cultivars, improved production systems and technical expertise may produce high yields in addition to transplant age. Relatively young transplants are preferred for commercial production under arid conditions because older seedlings are costly and difficult to handle (Zeidan, 2005).

Table .2. Distribution of greenhouses according to age of transplants.

Days	Frequency	%
30	13	39.4
35	10	30.3
40	10	30.3
Total	33	100

Plant density:

The majority of farmers (63.6%) grow tomato in high plant density (30cm). Only 36.4% of them use more than 30cm between plants (Table 3).Optimal plant density depends on cultivars, length of growing cycle, seasonal changes, climate, training and pruning of the crop. Other considerations include greenhouse design and climate control (particularly ventilation rate).

The optimum space between tomato plants in the greenhouse is generally agreed to be 35cm to 40cm. However, to facilitate working space between plants, double rows are recommended **(**Papadopoulos, 1992).Generally, high plant density improves light interception, but if the ventilation rate is low, disease problems occur and can become severe very quickly, requiring frequent pesticide spraying. Plant density should be lower in long-cycle crops than in short-cycle crops. Increased plant density results in increased biomass production due to enlargement of the total crop leaf area, while single plant fresh weight and fruit size are restricted (Yang *et al*, 2009).

Table.3. Distribution of greenhouses according to the plant spacing.

Plant spacing(cm)	Frequency	%
30	21	63.6
More than30	12	36.4
Total	33	100

Fertilization

Table 4 shows that the majority of farmers (75.8 %) had no specific fertilizer programs. There is a general belief that abundant nutrient application is needed for high yield and quality. As a result, growers tend to over fertilize tomatoes. This results in excessive application of nitrogen, phosphorus and potassium which results in low yield. Micronutrients are often applied with NPK fertilizers when deficiency symptoms are visible. In some cases, excessive application of one or more nutrients is accompanied by inadequate supply of other nutrients. To prevent such problems, a balanced fertilization program based on knowledge of plant nutrient requirements and soil nutrient reserves is needed. .Fertigation can be used for the adjustment of the amount and concentration of the applied nutrients according to tomato needs throughout the growing season. In order to supply nutrients to the crop effectively, the farmer must know the optimal daily nutrient consumption rate during the growing season for maximum yield and good quality (Scaife and Bar-Yosef, 1995).

Table 4. Distribution of greenhouses according to fertilization.

Fertilization	Frequency	%
No-program	25	75.8
Program	08	24.2
Total	33	100

Pruning interval

The majority of the farmers (90.9 %) pruned tomato to one stem by removing all lateral shoots weekly, 6.1% after 10 days and 3.0% after 15 days (Table 5).Results revealed that most farmers pruned tomato in the right intervals (every 7 days) since late pruning of side shoots has a negative effect on crop performance because it results in developing side shoots which compete with fruits; and also increases the risk of disease infection. The growing season, climatic conditions, in- row spacing and cultivars should be taken into consideration when deciding the number of stems per plant (Tuzel, 2013**)**.

Table.5. Distribution of greenhouses according to pruning interval.

Pruning interval(days)	Frequency	%
7	30	90.9
10	02	6.1
15	01	3.0
Total	33	100

Pest and disease control

Table 6 shows that all farmers (100%) used pesticides for pest control. There are no registered pesticides approved for use on the specific greenhouse crops grown in the Sudan. Pests enter greenhouses through cooling pads and during opening of doors. Plants in protected agriculture become more susceptible to pests and diseases for several reasons, including monoculture cultivation and the use of selected, high-yielding varieties (Abdelhaq, 2013**)**. Greenhouses are also designed to maintain ideal environmental conditions for crops. These conditions are also favorable for pests and pathogens (optimal humidity, temperature, no rain and no wind). Pests and pathogens may, therefore, be more prolific and cause more damage in greenhouses than in open field conditions (Tuzel, 2013**)**.

Farmers rarely implement systematic monitoring of pests and diseases in greenhouses as the basis for plant protection decisions, which leads to overuse of pesticides. Greenhouse management for the control of insects and diseases depends on the local climate, external disease and insect pressure, the greenhouse structural design, availability of climate control equipment, and the skill level of the greenhouse workers (Marwan, 2013).

Table.6. Distribution of greenhouses according to pest and disease control.

Pesticide	Frequency	%
Using	33	100
Not using	0.0	0.0
Total	33	100

Tomato yield:

Results revealed that 48.5% of the farmers did not produce any tomato yield during the summer season, 42.4% of them got 1.30 -2.65 kg/m^2 and only 9.1% of farmers harvested 6.10 kg/m^2 (Table7). Greenhouse tomato yield ranges between 6-12 kg/ m^2 in Mediterranean countries and 30-60kg/m^2 in the Netherlands (Tuzel, 2013). Most of greenhouse growers in Sudan failed to produce summer tomato because of unfavorable microclimatic conditions and high incidence of pests and diseases which resulted from drawbacks and shortcomings of the existing traditional greenhouses, like single doors that lead to the entrance of hot air and insects. It seems that these greenhouses were not constructed according to the recommended standard specifications. In addition, greenhouses had screens with inappropriate mesh size which allowed the entrance of insects such as thrips and white flies which transmitted the yellow leaf curl virus disease and consequently led to zero yield. Also, lack of the use of the double door system and the uncontrolled movement of workers encouraged the entrance of insect pests (Ibrahim *et al,* 2016). Our observations also indicated that when tomatoes were successfully produced they were subjected to overuse of pesticides. In addition there are no specific cultivars selected for tomato greenhouse production in Sudan. As a result, most of the growers were forced to change from tomato to cucumber production.

Table7. Distribution of greenhouses according to tomato yield .

Tomato yield (kg/m^2)	Frequency	%
0.0	16	48.5
1.30	05	15.2
2.60	09	27.2
6.10	03	09.1
Total	33	100

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الوضع الراهن لإنتاج الطماطم في البيوت المحميه في ولايتي الخرطوم والجزيرة بالسودان

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الخلاصة

ازداد انتاج الطماطم في البيوت المحميه فى السنوات الأخيرة في السودان. تهدف هذه الدراسة إلى تقييم العمليات الفلاحية للطماطم المزروعة في البيوت المحمية في ولايتي الخرطوم والجزيرة وتحديد اوجه القصور وأسباب تدني الانتاج. جمعت المعلومات في 2013م بعمل مسح بالاستجواب المباشر للعينة باستخدام الاستبيان لجمع المعلومات المطلوبة, وتم تحليل المعلومات باستخدام البرنامج الإحصائي للعلوم الاجتماعية, وتم حساب التكرار والنسبة المئوية للتحليل الوصفي. أوضحت النتائج عدم وجود اصناف موصي بها لزراعة الطماطم في البيوت المحميه وإن أغلبية مزارعي البيوت المحميه(48.5%) يقومون بشتل الطماطم في منتصف فبراير, كما أنّ الأغلبية(63.6%)من المزارعين يزرعون الطماطم في كثافة نباتية عاليه (30 سم) و75.8% لا يقومون بتسميد المحصول وفق برنامج معلوم. كما أوضحت النتائج أنّ معظم مزارعي البيوت المحمية (90.9%) يقومون بتقليم الطماطم اسبوعياً. وإنّ 100% من المزارعين فى البيوت المحمية يستخدمون المبيدات لمكافحة الحشرات والامراض. أوضحت الدراسه إنّ معظم المزارعين فشلوا في انتاج الطماطم الصيفية, بناءاً علي هذه الدراسة توجد حاجة الي إجراء بحوث اضافية لإنتاج الطماطم في البيوت المحمية .