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Effects of Weeding Frequency on the Yield and Shelf-life Performance of Tomato *(Lycopersicon Lycopersicum* (L) *Mill.)*

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Abstract

This study assessed the effects of different weeding frequencies on the yield, performance and shelf life of tomato. Plants under two weeks weeding interval, excelled in terms of growth, yield and storage performance compared to control and other plants under different weeding frequencies. The loss of frit it quality and rate of decay depended on the weeding frequencies and storage methods. For all the parameters investigated, fruits from no weeding (control) appeared to be more perishable in all the three storage methods than 2 weeks weeding interval. Incubator was the most effective storage method but not significantly different from that of evaporative coolant structure irrespective of the weeding frequencies Evaporative coolant structure was discovered to be more beneficial and convenient for the rural farmers because it is cheaper, accessible and stores tomato fruits well for a considerable length of time.

Keywords: Tomato yield, Weeding Frequency, Shelf-life, Storage Structure.

Introduction

Tomato is grown in different parts of the world due to its adaptability and universal acceptance. The great economic importance of tomato makes it one of the most popular and widely grown vegetable crops in the tropics. It provides a ready source of income to the farmer, a rich source of minerals, vitamins A and C, hence it is used in making stew and fruit and vegetable salads.

Tomato production in the tropics is being affected by weed competition, pests and diseases, but the greatest problem still lies with storage as the crop is highly perishable. This is the reason why there is 'glut' in its supply during the wet season and scarcity during the dry season, so an equilibrium has to be reached and maintained to allow for good quality tomato supply to the market all year round.

The effect of weeds on the yield and performance of any crop varies with the characteristics of the crop, weed species, density, the environment, the stage of growth and the duration of crop exposure to weeds. The cost of weed control remains high in Nigeria tomato production system, so it is necessary to study the critical period of weed competition with tomato so that efforts will be directed to its eradication at that stage. Kasasian and Seeyaye (1969), reported that the critical period of weed competition in tomato was the first month after transplanting, while William and Warren (1973) noted that the critical period was between 3 and 5 weeks after transplanting. It was also found out by Kasasian and Seeyave (1969), that tomato plant kept weed free after two weeks of transplanting gave almost a 100% yield, weed free after four weeks 90.8%, six weeks gave 72.9% and ten weeks gave 30.6% of the yield.

The sum total of the effect of. weeds on tomato storage and post-harvest loss in the tropics is fairly put between 20-50%. Robertson and Creech (1984), reported that temperature influences ethylene production, oxidation and carbondioxide production in stored fruits, and the objective of post harvest storage is to control the rate of ripening. Relative humidity affects moisture loss but high moisture content favours decay by organisms. The provision of a low cost storage material has been an area of research for food technologist, but the essence of this study is to evaluate in greater detail, the effect of frequency of weeding on the yield and shelf life performance of tomato fruits.

Materials and Methods

The experiment was conducted at the back of Agronomy Department, University of Ibadan, Ibadan (7° 20'N; 3° 45'E), during the 1999 cropping season, on a sandy loam soils previously cultivated to maize crops. Seedlings were raised for four weeks in the nursery before transplanting to the field. The variety planted was 'Ibadan local'. There were five weeding frequencies used as treatments viz: weeding at two weeks interval, weeding at two weeks after transplanting alone, weeding at flowering alone, weeding at fruiting and no weeding (control). The experimental design was a randomized complete block with a total of five treatments replicated three times.

The field was cleared and 15 beds measuring 2m x 2m were made. Strong and healthy seedlings were transplanted at 0.60m apart with each bed containing 16 plants. Weeding was done on all the treatments as required except for the control experiment. Also, routine agronomic practices of watering and staking a month after transplanting, were done manually. The seedlings were sprayed against pests with Vetox 85 and against diseases (e.g. fungi) using Dithane M-45 from two weeks after transplanting. Pre-planting soil samples were taken and analyzed.

Twelve plants per plot were randomly tagged for data collection. The parameters taken included, plant height, number of leaves, days to 50% flowering, stem diameter, number of branches, fruit number of fruit and fruit yield.

The storage experiment was conducted after the harvest of the fruits in the special laboratory within the Department of Agronomy, University of Ibadan. Tomato fruits were harvested early in the morning before sunrise, from all the weeding frequency treatments. The fruits were treated with warm water for two minutes to control micro-organisms affecting tomato in storage (El-sayed, 1978) and their initial weights were taken before storage. The storage systems used were the open shelf storage at 31°c, incubator storage at 10°c and pot-in-pot evaporative coolant structure (ECS) at 23°c. Twenty treated tomato fruits from the 12-tagged plants were randomly selected from each treatment, packed in perforated polyethylene bags, labelled and stored at 10°c in the incubator for 20 days.

In the open shelf storage, the twenty treated tomato fruits from the twelve tagged plants in each treatment were also randomly chosen, labelled and displayed on the open shelf at storage temperature of 31°c. The incubator used is a mechanical cooling device that is graduated into temperature angles which can be controlled and kept constant during the period of storage. The evaporative coolant structure (ESC) used was a portable model (pot-in-pot), described by Babarinsa and Nwagwa (1984). It consists of two burnt clay pots, one placed inside

Table 1: Ratings given for quality, pedicel and calyx discoloration, percentage decay-free, percentage marketable and percentage fresh weight loss of tomato fruits.

Parameter	Rating	Reference
Quality (1-9)	1-Unusable 3 –Unsaleable 5-Fair 7-Good 9-Excellent	Sherman et al (1982) Mohammed et al (1991)
Pedicel and Calyx Discoloration (1-5)	1-100% brown black 2-25% green 3-50% green 4-75% green 5-100% green	Risse and Miller (1983); Mohammed et al (1991)
Decay (1-5)	1-None 2-slight, not objectionable 3-Moderate, objectionable 4-Severe, decay extended to walls of fruits 5-Extreme, completely decayed	Sherman and Allen (1983); Mohammed et al (1991)
Fresh weight loss (%)	Weights of fruits were taken Before and after storage periods to calculate percentage fresh weight loss	Mohammed et al (1991)
Decay free (%)	Number of fruits receiving a decay rating of 1 was used to calculate percentage decay free	Sherman and Allen (1983); Mohammed et al (1991)
Marketable (%)	Number of fruits receiving a decay rating of 1 or 2 was used to calculate percentage marketable	Sherman and Allen (1983); Mohammed et al. (1991)

the other and the space in between them was filled with riverbed sand and is constantly kept wet. The pot is coated externally with cement to prevent inside seepage of water. The cooling is based on the transfer of heat from the storage chamber to the riverbed sand which forms the cooling medium from where the heat is also sent out across the outer wall of the structure by evaporation. In the ECS with a storage temperature of 23°c, the twenty treated tomato fruits from the tagged tomato plants in each treatment were randomly sorted, packed in thin perforated polyethylene bags, labelled and stored in the inner pot. Potassium permanganate which was carried on diatomaceous clay enclosed inside a filter paper was also inserted to absorb carbon iv oxide released by the fruits. A wooden lid was provided to cover the inner pot

The samples in all the storage methods were examined after 5, 10, 15 and 20 day intervals for quality, colour, decay, pedicel and calyx discoloration, percentage fresh weight loss, percentage decay-free and percentage marketable fruits. (Sherman et al.. 1982; Sherman and Allen, Risse and Miller, 1983; Mohammed et al., 1991). Ratings for these parameters are outlined in Table 1.

Results and Discussion

All the treatments showed a rapid increase in plant height in the first four weeks after transplanting due to less weed interference. There was no significant difference among the treatment at 6 weeks after transplanting. The highest mean height (177cm) was found with no weeding experiment (control) followed by the height of 166.5cm for weeding at two week interval (Table 2). The highest growth in the control treatment was attributed to its vigorous competition (Zimbahi, 1980) with weeds for survival but the plants look so delicate in appearance. There was no statistical significant difference ($P < 0.05$) in the number of leaves among the treatments (Table 2). An appreciable number of leaves was observed in all the treatments but the treatment with two weeks weeding interval gave the highest of 74, due to its good vegetative growth and good development because of little or no competition with weeds compared with other treatments which were exposed to weeds.

There was an increase in mean stem diameter and number of branches for all the treatments with the highest found in treatment with two weeks weeding interval while other treatments performed poorly. This was also due to good vegetative growth and weed free environment in treatment with two weeks weeding interval.

The first flower initiation was observed on the forty-seventh day after planting in the treatment with two weeks weeding interval thus falling within the normal flowering period of

Table 2: Effect of frequencies of weeding on growth, yield and yield components of Tomato

Growth, yield and yield components	Weeding Frequency P	Q	R	S	T	LSD	S.E. (P<0.05)
Height per plant (cm)	177.00	166.50	129.30	150.85	131.00	NS	12.2
Number of leaves per plant	57.00	74.00	47.00	40.00	49.00	NS	6.5
Average stem diameter (cm)	10.85	12.00	8.58	9.88	9.55	NS	0.7
Average number of branches	9.25	15.50	4.00	3.75	3.00	NS	2.7
Average number of flowers	10.70	16.50	10.00	8.00	7.00	NS	1.9
Harvested fruits per plant (yield)	13.00	23.00	11.00	8.00	6.00	NS	3.3
Fresh weight of harvested fruits (g)	466.00	936.00	210.00	145.00	140.00	NS	169.2

Key:
P = No weeding (control)
Q = Weeding at two weeks interval
R = Weeding two weeks after transplanting alone
S = Weeding at flowering alone
T = Weeding at fruiting alone

tomato plant. All the other treatments showed a fairly regular pattern of flowering at fifty-sixth day after planting. The percent flower abortion was highest in the control experiment resulting from the smothering effects of weeds. No significant difference (P<0.05) was recorded in the number of flowers and number of harvested fruits among the treatments. Treatments with weeding at two weeks interval gave the first fruit and best yield in terms of quality, size and quantity, and a total number of 92 fresh fruits was harvested while the least number; 19 was obtained from the treatment with weeding at fruiting alone. The highest fresh weight of 835g was obtained in the treatment with two weeks weeding interval followed by the control treatment with 465g fresh weight (Table 2). The control treatment produced small size and low weight fruits due to weed competition. This detrimental effect of weeds on crops were severe when crops are least able to make the most efficient use of environmental resources for growth. Similar results on adverse effects of delayed weeding were reported by Kasasian and Seeyave (1969); William and Warren (1977) for tomato and Ndubizu (1979) for plantain.

The quality rating (Table 3) shows a decline in quality of tomato fruits for all treatments in the three storage structures as the storage period increases. The highest quality ratings of the fruits 7.0, 6.0 and 3.0 occurred with the incubator (10°c), evaporative coolant structure (23°c) and open shelf storage respectively from the two weeks weeding interval and were superior to those obtained with control and other treatments. Incubator with 10°c temperature recorded the best quality ratings irrespective of the weeding frequency treatments while open shelf storage had the least. These differences as observed in quality were also expressed in the other parameters investigated. For example, tomato fruits from two weeks weeding interval stored in incubator, ECS and open shelf storage in that decreasing order, had the least pedicel and calyx discoloration, percentage fresh weight losses and decay respectively. The quality ratings for tomato fruits from two weeks weeding interval in incubator storage were much higher than for fruits from other treatments particularly the control. The greatest fresh weight loss occurred with the open shelf storage for all the treatments and the least with fruit stored in incubator from all the treatments.

Tomato fruits from all the treatments in the three storage structures under this investigation shows some degree of decay (Table 3). Indeed, the fruits from two weeks weeding interval showed more decay free and marketable fruits than other treatments and the control in all three storage methods. The most effective storage method of 20 days was incubator both in terms of decay free and marketable fruits with ECS being the next best storage method.

The findings from this study showed that there was a lack of consistency in data on the quality and decay of fruits among the post-harvest storage methods. Some of the storage methods for example ESC and open shelf storage were not as effective over the longer storage intervals as the incubator. This can be attributed to varying temperatures and relative humidities in different storage structures, therefore they behaved differently with respect to their ability to maintain quality and reduce decay. Incubator at 10°c appears to provide a suitable temperature for keeping tomato fruits in storage, more so since chilling injury symptoms were absent at this temperature. A similar result was reported by Mohammed (1990) and Mohammed *et al* (1991) for hot pepper. Tomato fruits obtained from two weeks weeding interval proved to be less perishable in all the three storage methods than the fruits

Table 3: Effect of post harvest storage methods on % weight loss, quality, decay, % decay, % decay -free, pedicel and calyx discolouration and % marketability of tomato obtained from different weeding frequencies after 20 days storage period.

Parameters	% Fresh Weight			Quality			decay			% Decay-free Discoloration			pedicel and calyx			% Marketability		
Weeding	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
P	75.8a	10.la	8.8a	1.2b	2.6c	3.0b	5.0a	4.5a	4.0a	50b	60b	65c	1.0b	1.8b	2.0b	30b	35c	40c
Q	45.6d	4.0c	3.6b	3.0a	6.0a	7.0a	3.0b	2.5b	2.0b	62a	78a	86a	2.0a	2.8a	3.0a	55a	70a	80a
R	55.6c	6.8b	4.2b	2.6a	4.8b	6.8a	4.2a	3.8a	2.5b	55b	69a	78b	1.6b	2.0a	2.5b	35b	55b	75b
S	67.2b	9.2a	8.5a	1.0b	2.5c	3.2b	4.8a	4.5a	3.5a	48c	55b	65c	1.2b	1.5b	1.7c	15c	35c	40c
T	72.8a	10.5a	8.2a	1.0b	2.2c	3.0b	4.9a	4.0a	3.6a	45c	52c	62c	l.lb	1.4b	2.0b	15c	30c	38c
S.E		5.7			0.5			0.2			3.1			0.2			5.2	

Means in each column for different levels followed by common letter do not differ significantly at P < 0.05 or at level by Duncan's Multiple Range Test.

Keys:

A = Open shelf storage

B = Pot-in-pot evaporative cooling structure

C = Incubator.

from other treatments and the control as evidenced by findings for all parameters here investigated. The high loss in quality and perishability in the fruits from other treatments and the control could be attributed to the allelopathic effect of weeds on tomato crops where inhibitors like phenols and quinones (Price, 1974) are released which may have detrimental effect on shelf life of tomato. Relative humidity affect moisture loss, high moisture content favours decay organisms, relative humidity is also related to temperature and a relative humidity of 85-95% is usually recommended for fruit vegetables (Babatola and Olaniyi, 1997). All this affect open storage method which have poor performance for all the parameters under this investigation compared with incubator and ECS storage methods.

Conclusion

It can be concluded that the incubator storage was the most effective for storing tomatoes at 10°c over a storage period of 20 days whereas the ECS was found to be equally as good and more economical for the use of the farmer. Therefore, ECS is preferred and recommended to farmers who do not have ready accessibility to electricity to power their incubator.

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