ECRONICON OPEN ACCESS

EC AGRICULTURE
Research Article

Growth and Yield Response of Tomato (*Lycopersicon esculentum* Mill) to Water Stress at Different Phenological Growth Phases

Omotunde HA[1]*, Bodunde JG[1] and Busari OM[2]

[1]*Department of Horticulture, Federal University of Agriculture, Abeokuta, Nigeria*

[2]*Department of Horticultural Technology, Oyo State College of Agriculture and Technology, Igboora, Nigeria*

***Corresponding Author:** Omotunde HA, Department of Horticulture, Federal University of Agriculture, Abeokuta, Nigeria.

Received: February 04, 2020; **Published:** March 24, 2020

Abstract

Growth and yield response of tomato (*Lycopersicon esculentum* mill) to water stress at different phenological growth phases was conducted in the Screen house at the Federal University of Agriculture, Abeokuta in 2013. The experiment was 2 x 5 factorial laid out in Completely Randomized Design with three replicates. Treatments consisted of two varieties of tomato (Roma and Beske) and Watering to Field Capacity (WFC) at 20%, 40%, 60%, 80% and 100% (Control). Data collected on phenological growth phases were analyzed. Result revealed that Beske variety significantly ($P < 0.05$) had better vegetative phase (50.42), number of leaves (26.00), flowering (67.04), fruiting (89.50), number of fruits per plant (1.27) and fruit yield (5.00) when compared to Roma. Watering to field capacity (WFC) at 60% had significantly ($P < 0.05$) best flowering stage (70.14) and days to 50% flowering (46.6) when compared to other % WFC while 80% WFC had significantly ($P < 0.05$) best fruiting stage (96.50), number of leaves (24.96) and number of fruits per plant (1.89) when compared to other %WFC. It is concluded that Beske variety continue to grow after flowering to enhance fruiting while watering to field capacity between 60% and 80% is the optimum water regime for vegetative growth, flowering and fruiting of tomato.

Keywords: *Tomato (Lycopersicon esculentum Mill); Water Stress; Phenological Growth Phases*

Introduction

Tomato (*Lycopersicon esculentum* Mill) belongs to the large and diverse plant family solanaceae. It is an annual crop with a weak, trailing stem covered with glistening yellow glandular hairs. The use of irrigation is viewed as a key factor to increase year round production and supply of food. The planning and ultimate success of improving the productivity and efficiency of irrigation agriculture however requires a comprehensive framework of basic water management data including yield response to water use. In Nigeria, the small holder traditional irrigation along the country's fadama covers about 90% of the total irrigated land [1].

Excessive watering and improper irrigation techniques lead to non-uniform distribution of water in the crop field, which reduces yield. Singandhupe., *et al*. [2] found out that poor developments in soil and crops could be prevented by applying water to the effective root zones with low volume application of water under low pressures by micro irrigation. Water use efficiency (WUE) obtained by drip irrigation was found to be 68.0 - 76.8% more than water application of furrow irrigation.

Water stress and drought conditions have wide-ranging effects on the morphological and physiological processes of plants. This research was done for the proper understanding of drought tolerance mechanism in tomato, considering the current threat of climate change.

Materials and Methods

The experiments were conducted in the screen house of College of Plant Science and Crop Production, Federal University of Agriculture, Abeokuta (Latitude 7° 15′ N, Longitude 3° 25′ E), Nigeria between May and September 2013 Seeds were sown on nursery bed for four weeks after which seedlings were transplanted into the experimental pots.

Soil for the pot experiment was collected from the Organic Farm at FUNAAB and sieved using mesh before each pot was filled with 5 kg of the soil. The experimental design was 2 x 5 factorial arrangements in a Completely Randomized Design (CRD) with three replications. The treatments comprised of two varieties of tomato (Roma a determinate variety and Beske an indeterminate variety), soil moisture stress at five levels of 20%, 40%, 60%, 80% and 100% (control) water field capacity (WFC) each imposed at three phenological growth phases of tomato i.e. vegetative growth phase (3 WAT to 6 WAT), flowering growth phase (6 WAT to 9 WAT) and fruiting phase (9 WAT to senescence stage).

Field capacity was determined by pouring a 1500 ml of water into the pot containing the air dried soil and the excess allowed to drain-out for 48 hours. The volume of drained water was measured and this was subtracted from the amount poured into the pot. This quantity (difference) equated the amount of water required to bring the soil to field capacity.

Data collected weekly on plant height, number of leaves per plant, Days to first flowering**,** Number of Fruits per plant, Fruit diameter and Fruit yield per plant were analyzed using Analysis of variance (ANOVA) and Treatment Means were separated using Least Significant Difference (LSD) at 5% probability level.

Results

The result showed that Beske variety of tomato gave significantly ($P < 0.05$) better vegetative growth phase (50.42) when compared to Roma (44.42). Flowering and Fruiting growth phase followed the same trend as vegetative growth phase where Beske had better flowering and fruiting growth than Roma phase but the difference was not significant (Table 1). Though not significant, Tomato varieties treated with 80% Watering to Field Capacity gave the best vegetative growth but had the significantly ($P < 0.05$) best fruiting growth phase (96.50) compared to 60% WFC (93.40), 40% WFC (87.10), 20% WFC (73.30) and 100% (control) WFC with the least fruiting growth phase. Tomato varieties with 60% watering to Field Capacity (WFC) gave significantly ($P < 0.05$) best flowering growth phase (70.14) followed by 80% WFC (68.88), 40% WFC (66.26), 20% WFC (61.11) and 100% WFC (59.80) (Table 1).

There was no significant difference between the two varieties and among % WFC in the days to first flowering. Beske had significantly

	1st flowering	50% flowering
Variety		
Roma	34.0	55.5
Beske	31.6	48.8
LSD (0.05)	NS	2.5
% WFC		
20	31.2	54.9
40	31.9	53.6
60	36.8	46.6
80	35.6	50.6
100	28.3	54.9
LSD (0.05)	NS	3.9

Table 1: *Plant height (cm) of tomato at different phenological growth phases as influenced by variety and water regime. NS: Not Significant*

($P < 0.05$) earlier 50% flowering (48.8) when compared to Roma (55.5). 60% WFC had significantly ($P < 0.05$) earliest 50% flowering (46.6) when compared to 80% WFC (50.6), 40% WFC (53.6), 20% WFC and 100% WFC (54.9) (Table 2).

	Phenological Growth Phase		
	4 WAT Vegetative	**6 WAT Flowering**	**9 WAT Fruiting**
Variety			
Roma	44.42	66.16	85.70
Beske	50.42	67.04	89.50
LSD (0.05)	3.84	NS	NS
%WFC			
20	48.08	61.11	73.30
40	47.77	66.26	87.10
60	45.11	70.14	93.40
80	48.72	68.88	96.50
100	47.78	59.80	70.40
LSD (0.05)	NS	4.20	6.83

Table 2: *Days to first and 50% flowering of tomato as influenced by variety and water regime.*
NS: Not Significant.

Beske had significantly ($P < 0.05$) higher number of leaves throughout the growth phases (vegetative, flowering and fruiting) when compared to Roma (Figure 1). Watering to field capacity at 80% had significantly ($P < 0.05$) highest number of leaves throughout the growth phases (vegetative, flowering and fruiting) when compared to 60% WFC, 40 WFC, 100 WFC and 20% WFC (Figure 2). Beske had significantly ($P < 0.05$) higher number of fruits per plant (1.27), fruit diameter (11.6) and fruit yield (5.00) when compared to Roma (0.62, 4.10 and 1.81 respectively). Varieties treated at 80% WFC had significantly ($P < 0.05$) highest number of fruits per plant (1.89) when compared other %WFC. There was no significant difference in the %WFC for the fruit diameter and fruit yield.

	Number of fruits per plant	**Fruit Diameter (mm)**	**Fruit Yield (g/plant)**
Variety			
Roma	0.62	4.10	1.81
Beske	1.27	11.6	5.00
LSD (0.05)	0.55	5.36	2.43
%WFC			
20	0.00	2.4	0.78
40	0.78	8.70	3.28
60	1.06	10.1	4.89
80	1.89	10.2	4.67
100	1.00	8.90	4.00
LSD (0.05)	0.86	ns	ns

Table 3: *Fruit diameter (mm) and Fruit yield (g/plant) of Tomato as influenced by variety and water regime.*
ns: Not Significant.

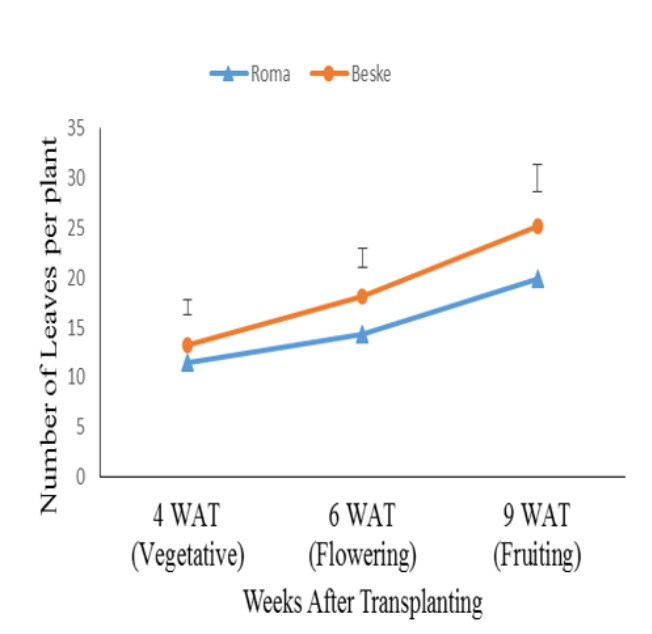

Figure 1: *Number of leaves per plant of tomato at different phenological growth phases as influenced by tomato varieties.*

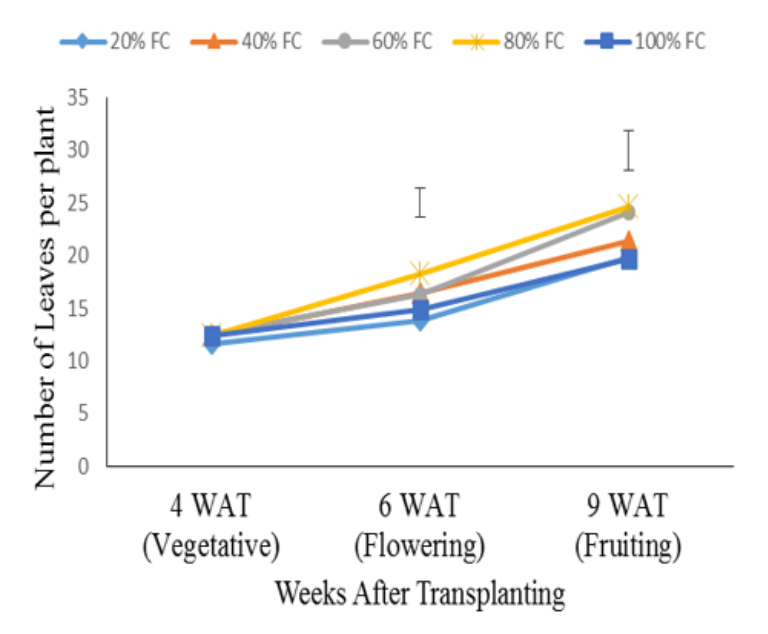

Figure 2: *Number of leaves of tomato at different phenological growth phases as influenced by water stress levels.*

Discussion

Vegetative parameters of tomato were significantly affected by water regime. Consistently, variety Beske had higher values of vegetative parameters than Roma variety probably due to inherent differences in their respective morphology characteristics. With respect to height and other vegetative parameters, Beske being an indeterminate genotype continues its vegetative growth even after flowering which may be the major reason why it was significantly different from Roma variety which is a determinate variety. The total number of leaves and branches produced by plants is a factor that is closely related to fruit production because the total number of leaves at flowering stage greatly affects the amount of photosynthate accumulated by a plant [3].

Effect of water stress on plant height and number of leaves of tomato was significant at the flowering and fruiting phenological growth phases. The production of taller tomato plants, higher number of leaves at water regime of 60% field capacity could indicate that the regime is optimum for tomato plant use, similar result was reported by Singandhupe., *et al*. [2] and Nahar and Ullah [4] on tomato.

100% FC status was in excess for tomato plants, while water regime of 20% or 40% field capacity was probably insufficient for physiological functioning of tomato plants especially in the production of fruits. This result corroborated the findings of Nahar., *et al.* [5] who observed higher yield in stressed than in non-stressed condition. It also agrees with the findings of Hamid., *et al*. [6] who observed the lowest yield per plant in the 100% field capacity and showed susceptibility to the lower soil moisture regimes.

Conclusion

In conclusion, it is evident that better phonological growth phase of Beske variety is due to its continuous growth after flowering. 60 - 80% Watering to Field Capacity (WFC) is the optimum range of water regime for the two varieties (Beske and Roma) of tomato.

Bibliography

1. Pradhan O. "Research priority of irrigation management in Nigeria". In: Irrigation Research Priorities for Nigeria (Nwa EU and P Pradhan, ed) Proceedings of a National Seminar Ilorin, Nigeria (1993): 19-32.

2. Singandhupe RB., *et al*. "Fertigation studies and irrigation scheduling in drip irrigation system in tomato crop (*Lycopersicon esculentum* L.)". *European Journal of Agronomy* 19.2 (2003): 327-340.

3. Ajayi EO. "Effects of sowing dates of Melon intercropped with Rice on crop growth and yield". Unpublished M.Sc. Thesis, Postgraduate School, Federal University of Agriculture, Abeokuta (2004): 47-51.

4. Nahar K and Ullah SM. "Morphology and physiological characters of tomato (*Lycopersicon esculentum* Mill) cultivars under water stress". *Bangladesh Journal of Agricultural Research* 37.2 (2012): 355-360.

5. Nahar K., *et al*. "Influence of soil moisture stress on height, dry matter and yield of seven tomato cultivars". *Canadian Journal of Scientific and Industrial Research* 2.4 (2011).

6. Hamid A., *et al*. "Photosynthesis, transpiration, dry matter accumulation and yield performance of Mung bean plant". *Journal of the Faculty of Agriculture, Kyushu-University* 35.1-2 (1990): 81-92.

Volume 6 Issue 4 April 2020