

Effect of Age at Transplanting on Yield and some Yield Components in Tomato, *Lycopersicon esculentum*, mill

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Abstract

Age at transplanting significantly affected fruit yield, mean fruit weight and establishment count in five cultivars of tomato, *Lycopersicon esculentum*, Mill., evaluated for three years at the University of Ife, Ile-Ife, Nigeria. There was no genotype x transplanting age interaction. Raising tomato seedlings in the nursery for five weeks before transplanting is the optimum period under our condition. Establishment count, fruit number and mean fruit weight had large total effects while delayed flowering had a negative total effect on yield in tomato. Every trait investigated had a positive (though small) direct effect on yield through age at transplanting.

Introduction

Tomato, *Lycopersicon esculentum*, Mill, is an important food item in Nigeria. The food value of its fruit is enhanced by the fact that it can be eaten raw. Thus, the vitamins A, B and C the fruit contains (Greensill, 1968) need not be lost in cooking.

The fruit yield from a tomato plant is an expression of the plant's whole genotype, but viewed mechanistically it is a product of the number of fruits and mean fruit weight (Fatunla, 1973). Other factors that contribute to yield in tomato include establishment count, days to 50% flowering and age at transplanting. The possible contribution of age at transplanting to yield in tomato has long been appreciated by many workers (Norman 1977, Walkoff 1960). Thus, while few farmers still plant tomato seeds directly on the field, a great majority of them raise seedlings in the nursery before transplanting. Walkoff (1960) recommended nursing seedlings for four weeks, before transplanting. Adelana (personal communication) suggested a nursery

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period of 3 to 4 weeks. However, early rains are uncertain. To have better stability of rains, therefore, it may be necessary to delay transplanting for a week or two (after the suggested 3 – 4 week nursery period).

The primary objective of this study is to determine if the unavoidable delay in transplanting due to uncertain rains result in significant genotype X "age at transplanting" effect thus reducing the probability of detecting significant differences between cultivars or treatments when they exist. In addition, using path analysis, the direct and indirect contributions of age at transplanting, mean fruit weight, number of fruits/per plant, establishment count and date of 50% flowering to yield are reported.

Materials and Method

Five cultivars of tomato, S15P11, Ife 1, 191B (Ife II), 6/41 and 7/47 were used in this study. Seeds of the cultivars were first sown in wooden trays filled with sterilized soil in the screen-house on 27th July, 1981. Each cultivar was planted in 3 trays. Three similar sowings were carried out at one week intervals. All the seedlings were transplanted to the field exactly four weeks after planting the last batch.

The field design was a randomized complete block with three replicates. Each replicate consisted of 20 plots. The twenty treatments (5 varieties at 4 planting dates) were randomized within each replicate. In each plot there were 9 rows of 8 plants each with a spacing of 0.5m between and within rows. A space of one metre separated one block from the other. Fertilizer was applied at the rate of 50kg N/ha., 100kg P₂O₅/ha as sulphate of ammonia, single superphosphate and muriate of potash respectively. Missing stands were supplied a week after transplanting from plants of the same age. Extent of establishment was assessed about two weeks after transplanting while the date of 50% flowering was also noted for every plot. Number of fruits and fruit weight for each plot were recorded after each harvesting. This experiment was repeated in 1982 and 1983.

A combined analysis of variance was computed for the 3 years following the procedures outlined by Steel and Torrie (1960). Path-coefficient analysis (Wright, 1921, Wilson et al. 1981) was used to determine the inter-relationships among all the traits in the combined sets of data.

Results and Discussion

The mean values of the varieties at different ages of transplanting are presented in Table 1 while the path diagram and correlation coefficients are given in Fig. 1. Age at transplanting had significant effects on fruit weight, mean fruit weight and establishment count in the five cultivars of tomato evaluated in this study (Table 2). The cultivars behaved consistently at whatever age the crop was transplanted. Thus there was insignificant genotype x transplanting age interactions (Table 2). There was, however, significant

Table 1: MEAN FRUIT NUMBER, YIELD FRUIT SIZE, ESTABLISHMENT COUNT (EC): FLOWERING DATE IN TOMATO AVERAGED OVER 3 YEARS AND 3 REPLICATES.

Variety	ATP+ weeks	Fruit No.	Yield (kg.)	Fruit Size (gm)	EC ++	Flow date
S15P11	4	1176±220	24.9±2.9	24.4±1.7	87.7±2.8	22.2±0.9
	5	1176±259	24.8±4.1	23.7±1.8	88.1±2.5	23.2±2.4
	6	1049±201	23.9±2.6	25.9±2.4	86.0±1.4	24.2±1.3
	7	936±119	20.5±1.3	23.3±1.7	86.5±1.1	23.5±2.2
IFE 1	4	659±89	19.6±2.3	30.7±1.5	77.6±4.5	24.6±1.9
	5	741±96	25.3±2.7	35.0±2.0	88.2±2.1	22.1±2.2
	6	673±96	20.2±2.1	31.4±1.6	88.6±1.4	22.0±6.0
191B	7	683±105	21.6±2.2	33.3±1.8	80.9±5.6	23.4±2.1
	4	724±103	20.9±2.2	30.3±1.5	77.4±3.3	24.4±2.0
	5	737±103	24.5±2.6	34.4±1.3	86.1±3.6	20.4±3.1
	6	654±72	21.0±2.2	32.5±1.5	86.6±3.7	24.3±2.1
6/41	7	615±87	19.5±2.4	31.1±2.7	84.9±3.5	22.7±2.1
	4	949±171	19.2±2.4	21.6±1.4	77.1±8.7	22.5±1.8
	5	1178±188	24.5±2.2	22.2±1.3	92.7±1.6	23.5±2.2
7/47	6	1176±163	24.6±1.0	21.9±1.0	88.5±2.5	23.8±2.2
	7	1113±146	24.9±1.8	23.7±1.4	81.6±4.5	23.6±1.9
	4	829±118	19.9±2.1	25.6±1.3	85.5±4.5	24.0±1.9
	5	865±108	21.6±2.2	25.5±0.8	86.4±3.2	24.8±1.6
	6	883±124	22.1±2.5	25.4±1.2	88.6±2.6	23.2±2.2
	7	858±121	22.2±2.1	27.3±1.7	83.8±4.1	22.1±2.2
LSD						
	(0.05)	197.34	4.86	3.01	9.73	2.58
	(0.01)	260.84	6.41	3.98	12.86	3.42

+ ATP — Age at transplanting.
 ++ EC — Establishment count.

Table 2: ANALYSIS OF VARIANCE TABLE SHOWING MEAN SQUARES FOR FRUIT NUMBER (MS₁) YIELD (MS₂) MEAN FRUIT WEIGHT (MS₃) ESTABLISHMENT COUNT (MS₄) AND 50% FLOWERING (MS₅).

Source	df	MS ₁	MS ₂	MS ₃	MS ₄	MS ₅
Years (yr)	2	9399496 ^{**}	2134.4 ^{**}	958.3	1631.0	2344.1
Rep/Year	6	173168 [*]	95.3	33.4	452.0	55.9
Genotype (Gen)	4	1510944 ^{**}	37.7	827.3	119.0	2.0
Gen. X Yr	8	433422 ^{**}	64.4	30.6	111.5	1.1
Age at Transpl. (ATP)	3	79621	83.9 [*]	33.7 [*]	523.0 ^{**}	2.0
ATP x Yr.	6	47960	26.0	13.2	113.6	14.3
Gen. x ATP	12	48476	32.6	13.9	100.5	9.6
Gen. x ATP x Yr	24	40728	18.7	11.4	92.6	11.9
Error	114	44701	27.1	10.3	108.6	7.6
Total	179	204083	54.9	41.7	141.9	35.8

x₁ xx

Significant at 0.05 and 0.01 probability levels respectively.

Figure 1: Path diagram of the effects of some yield components on yield of tomato.

Legend:

- Y = Yield
- X₁ = Establishment count
- X₂ = Fruit number
- X₃ = Mean fruit weight.
- X₄ = 50% flowering.
- X₅ = Age at transplanting.

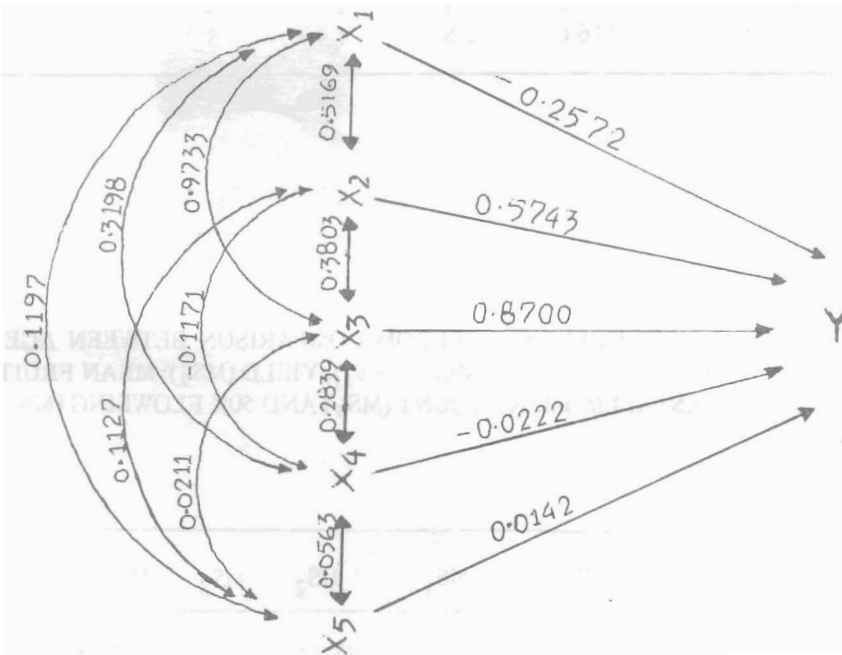


Table 3: MEAN PERFORMANCE FOR FRUIT NUMBER (M_1); YILED (M_2); MEAN FRUIT WEIGHT (M_3); ESTABLISHMENT COUNT (M_4); and 50% FLOWERING (M_5); AT EACH OF THE 4 AGES OF TRANSPLANTING.

Age transplanting	M_1	M_2 (Kg)	M_3 (g)	M_4 (%)	M_5 (Days)
4 weeks	865.3	20.9	26.3	81.1	23.3
5 weeks	939.8	24.1	28.1	88.3	23.5
6 weeks	887.4	22.4	27.4	87.6	23.5
7 weeks	841.1	21.7	28.1	84.1	23.1
LSD (0.05)	88.2	2.1	1.3	4.3	1.1
(c.01)	116.6	2.8	1.7	5.7	1.5

Table 4: SINGLE DEGREE OF FREEDOM COMPARISON BETWEEN AGE AT TRANSPLANTING FOR FRUIT NUMBER (MS_1); YIELD (MS_2); MEAN FRUIT WEIGHT (MS_3); ESTABLISHMENT COUNT (MS_4) AND 50% FLOWEING (MS_5).

Source	df	MS_1	MS_2	MS_3	MS_4	MS_5
Age	3	79621.3	83.9*	33.7*	52.3*	2.0
4 Vs 5 weeks	1	124847.1	233.2**	74.5**	1172.8*	0.9
5 Vs 6, 7 weeks	1	171007.5	129.1*	0.4	169.9	2.0
Error	114	44701.8	27.0	10.3	108.6	7.6

*, ** Significant at 0.05 and 0.01 probability levels respectively.

Table 5: DIRECT (ON DIAGONAL) AND INDIRECT (OFF DIAGONAL) EFFECTS OF SOME YIELD COMPONENTS ON FRUIT WEIGHT IN TOMATO

	X ₁	X ₂	X ₃	X ₄	X ₅	Total Indirect	Effect Coeff. (Dir. + Indir.)	Error
X ₁	-.2572	.2969	.8468	-.0061	.0017	1.1383	.8811	.0150
X ₂	.1329	.5743	.3309	.0026	.0003	.2009	.7752	.0020
X ₃	-.2503	.2185	.8700	.0063	.0016	-.0240	.8460	.0009
X ₄	-.0828	-.0667	-.2470	-.0222	.0008	.3973	-.4195	.6739
X ₅	-.03002	.0113	.0949	-.001223	.0142	.0774	.0916	.00019

- X₁ - Establishment count
- X₂ - Fruit weight
- X₃ - Mean fruit weight
- X₄ - 50% flowering.
- X₅ - Age at transplanting
- = - Direct effect.

differences between years as evident from the significant year mean squares for all the traits (Table 2).

The means of tomatoes transplanted at four weeks were lower than those transplanted at five weeks for fruit weight, mean fruit weight and establishment counts whereas the means of plants transplanted at five weeks were significantly higher than those of seven weeks for fruit number and yield (Table 3). Comparison between ages of transplanting further revealed that four week old transplants were significantly different from five week old transplants for yield, mean fruit weight and establishment count (Table 4). For mean fruit weight and establishment count, however, there was no significant difference between five, six or seven week old transplants (Table 4). Age at transplanting had little effect on when the cultivars flowered (Table 2, 3 and 4). Of all the traits investigated, establishment count had the greatest effect on yield in tomato. The total (direct and indirect) effects was 0.8811 (Table 5). Mean fruit weight was the next most important factor influencing yield. Although the effect of age at transplanting was minimum, it is, however, noteworthy that all the other traits had positive (albeit small) indirect effects on yield through this trait (Table 5). Time of flowering (50% flowering) has a negative effect on yield (Table 5).

Planting seeds in the nursery and transplanting the seedlings later allows for intensive care to be devoted to the seedlings during the early stages when they are most delicate, enables growers to select the most vigorous seedlings and allows the researcher to transplant when the weather condition is right. The individual total effects of establishment count, fruit number and mean fruit weight on fruit yield were high and positive. This suggests that the age at transplanting will affect yield principally through plant population per plot. We will expect, therefore that the age at transplanting that promotes maximum establishment of the tomato crop will give the highest tomato fruit yield. In this experiment, tomato transplanted at five weeks (from the date of planting) gave the highest stand count and consequently fruit yield.

It is worthy of note that although the tomato cultivars were at different ages at the time of transplanting, this had no significant effect on time of flowering. The time rather than the age at transplanting triggers flowering. The optimum age at transplanting represents a balance between vigorous plants that can easily establish on the field but sufficiently young to overcome the shock of transplanting. Five week old plants were found to establish better than four week old plants and recover from transplanting shock than six or seven week old plants. This is probably because seedlings kept too long in the nursery become woody and such plants do not make a quick start when set in the field. Similar conclusions were drawn by Norman (1977) for hot peppers (*Capsicum sinense*).

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