CRITICAL PERIOD OF WEED INTERFERENCE IN RAINFED AND IRRIGATED TOMATOES IN THE NIGERIAN SAVANNA

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Abstract

Field trials were conducted to assess the critical period of weed interference in tomato on the farm of the Institute for Agricultural Research Samaru (11^{0}11 'N, 07° 38'E) in the Northern Guinea Savanna ecological zone of Nigeria in 1989 and 1990 wet seasons and at the Irrigation Research Station of the Institute for Agricultural Research, Kadawa (11^{0}39'N, 08° 02'E) in the Sudan Savanna ecological zone of Nigeria in 1987/88 and 1988/89 dry seasons. Each trial consisted of two sets of treatments. One set of treatments consisted of plots initially kept weed free for 3, 6, 9 and 12 weeks after transplanting by weeding with hand hoes and subsequently kept unweded until harvest. The other set of treatments consisted of plots initially kept weed-infested for 3,6,9 and 12 weeks after transplanting and subsequently kept weed-free until harvest. Two treatments of weed-infestation and weed- free throughout the crop growth were also included as checks. In all the trials, weed interference beyond 6 weeks after transplanting (WAT) significantly depressed various crop growth parameters and tomato fruit yield compared with the crop kept weed-free throughout its life cycle. The crop was most critically affected by weed interference between 3 and 6 WAT. In order to obtain tomato fruit yield comparable to that of weed free check, it was required to keep the crop. weed-free for 6 weeks after transplanting and beyond. Weed infestation throughout the crop life cycle resulted in about 40 to 60% reduction in potential tomato fruit yield compared with the maximum yield obtained in each trials.

Key words: Weed interference, critical period, transplanted tomato.

INTRODUCTION

Of all the constraints limiting tomato production, weeds appear to have the most deleterious effect causing yield reduction of between 53 and 67% (Sanok *et al* 1979~ Usoroh, 1983, Sinha and Lagoke 1984). In Ontario, Canada, Friesen (1979), reported that the tomato crop kept weed-free for 36 days or weed-infested for 24 days after transplanting gave yield equal to those kept weed-free throughout the crop growth. He, however, observed that when weeds were allowed to remain in the crop for more than 24 days after transplanting, yields were progressively reduced. At Java, Everaats and Muchtar (1979) reported a yield loss of 36% due to weed competition until harvest although the crop kept weed-free for the first 4 weeks after transplanting did not suffer any yield loss.

The yields of direct sown tomatoes were reduced by 11.8, 71.7 and 97.9% when weeds were allowed to compete with the crop for 30, 60 and 90 days after sowing respectively (Armelina, 1983). Weaver (1985) also reported that yield of direct sown processing tomatoes was reduced by keeping the crop weed-infested for 5 weeks after sowing. Whereas yield of the crop kept weed-free for 28 days and more was similar to that kept weed-free throughout the crop life cycle. More recently Adigun *et al.* (1993) reported 40 to 82% reduction in tomato fruit yield due to unchecked weed growth throughout the crop life cycle.

The period of the crop growth when it is most susceptible to weed interference has been regarded as the critical period of weed competition (Nieto *et al,* 1968). In Maryland in the United States of America, Beste (1979) reported that tomatoes needed to be kept weed-free for 6 weeks after transplanting to avoid reduction in yield. In South Western Nigeria Usoroh (1983) demonstrated that weed competition in most cultivated varieties of tomato is most critical between transplanting and 6 weeks later. The impact of weeds on yields of crops varies with the characteristics of crop, the weed species, weed density, the environment, the stage of crop growth and duration of crop exposure to the weeds (Dowson *et aI1973).* Weeds constitute a major problem in tomato production. Apart from their direct effect on yield reduction, common weed species such as *'Amaranthus spinosus* (L) and *Solanum nigrum* (L) have been reported to serve as reservoir hosts for pests and diseases (Erinle, 1982, Alegbejo, 1987).

Although many competition studies (Blanco and Oliveira 1971, Dowson and Roberts, 1973, Friesen 1979, Usoroh, 1979, Lagoke *et al1988* Adigun *et a11992)* have been conducted in the temperate and tropical regions between direct seeded vegetable crops and indigenous population of weeds, there is at present paucity of published information on the effects of period of weed interference on transplanted tomato under the Nigerian conditions. A clear understanding of the stage of growth at which tomato is most sensitive to weed competition will facilitate the planning and implementation of weed control programme. Hence the objective of this study is to assess the critical period of weed interference in rainfed and irrigated tomatoes in the Nigerian Savanna.

MATERIALS AND METHODS

Field trials were conducted to assess the critical period of weed interference in tomato on the farm of the Institute for Agricultural Research, Samaru ($11^0$11 'N, 07^0 38'E) in the Northern Guinea Savanna ecological zone of Nigeria in 1989 and 1990 wet seasons and at the Irrigation Research Station of the Institute for Agricultural Research Kadawa (11 °39'N, 08° 02"E) in the Sudan Savanna ecological zone of Nigeria in 1987/88 and 1988/89 dry seasons. The soils of the experimental sites were deep freely drained sandy loam with 9.3 to 18% clay and 0.3 to 0.45 organic matter content. In all the trials, the land was ploughed and disc-harrowed at two-week intervals. Raised and sunken beds were prepared with hoes for wet and dry seasons, respectively with a gross plot size of (3.0 x 4.5)m^2 and a net plot size of(I.5 x 3.0) m^2. Six weeks old tomato seedlings (Var. Roma VF) were transplanted into the plots at inter and intra-row spacings of 60 and 45cm, respectively. Fertilizers at the rate of 30kgN, 45kg P_2O_5 and 45kg K_20/ha were applied at land preparation by broadcast and mixed with soil with hand-hoes, using calcium ammonium nitrate, single super-phosphate and muriate of potash as fertilizer sources, respectively. In addition, 30kgN/ha was applied as side dressing at 3WAT. During the dry season trials, the crop was irrigated twice per week from the time of transplanting until the first set of fruits were produced. Subsequently the crop was irrigated weekly until the final harvest.

Each trial consisted of two sets of treatments. In one set, plots were initially kept weed-free for 3, 6, 9 and 12 weeks, after transplanting by weeding with hand hoes and subsequently left un-weeded until harvest while in the other set of treatments weeds were initially allowed to complete with the crop for the corresponding periods and . subsequently controlled until harvest. Two treatments of weed-infestation and weed-free throughout the crop growth were also included as checks. Details of the treatments are contained in tables 2 to 5. Samples of fresh weeds were taken (one sample .from I.Om^2 quadrant in each plot) before any weeding was done and the cummulative fresh weed weight produced recorded at the final harvest. Other data obtained include crop vigour score, number of leaves and branches per plant, fruit number and fresh weight at the period indicated in tables 2 to 5. All the data collected were subjected to statistical analysis and the treatment means compared using Duncan Multiple Range Test (DMRT) where F-values were significant.

RESULTS AND DISCUSSION

The common weeds at the sites of the trials which included all categories of weeds and their levels of occurrence are presented in Tab. 1. The common broad-leaved weeds were *Acanthospermum hispidium* (DC) *Solanum nigrum* (L.), *Amaranthus spinosus* (L.), *Vernonia ambigua* (L.), *Vernomia galamensis* (Cass.) Less *Ageratum conizoides* (L.), *Ipomea aquiatica* (Forst.) *Portulaca oleracea* (L.), *Erphorbia hirta* (L.), and *Cleome viscosa (Schim* and *Thonn)* while the sedges were *Cyperus rotundus* (L.) and *Cyperus esculentum* (L.). Some grass species such as *Eleusine indica* (L.), Digitaria *ciliaris* (Rt) Knock, *Eragrostis tremula* (L.), *Chloris pilosa (Schum), Dactyloctenum aegyptium (L.)Richat* and *Cynodon dactylon* (L.) Pers. were also present.

Period of weed interference had significant effect on all the parameters in the dry season trials (Tables 2 and 3). Similarly during the wet seasons, all the parameters, except number of leaves and branches of tomato in the two wet seasons (Tables 4 and 5) and number of fruits in 1990, were significantly, affected by the period of weed interference. In all the trials initial weed infestation of the crop for only 3WAT did not have any significant effect on any of the crop growth parameters and tomato fruit yield provided the weeds were subsequently removed until harvest. Similarly, crop yield loss was not obviated by keeping the crop weed-free during the first 3 weeks of crop growth only (tables 2, to 5). This was probably because major weed/challenge occur mainly after 3 weeks once effective land preparation preceeded crop transplant. In addition, at the initial stage of growth, both crop and weeds have adequate amount of light, nutrients and water relative to their requirements. Hence, the effect of competition between weed and the crop was not severe at this stage. Similarly, other reports in the Nigerian Savanna by several workers have revealed that weed infestation for the first 3WAT did not cause any significant depression in crop growth and yield of pepper (Lagoke *et at* 1988, Adigun *et al*; 1992), cotton (Dadari, 1983, Okafor, 1987 and Okra (Adejonwo, 1988). However, initial weed infestation for 6 WAT and beyond resulted in significant depression of various growth parameters such as crop vigour score, leaf production and number of branches per plant and yield attributes including number of fruits and fruit weight compared with the crop kept weed-free throughout its life cycle.

In order to obtain comparable yield to the weed free check, it was required to keep the crop weed-free for 6WAT and beyond. This is in agreement with the observation of Usoroh (1983) who reported that weed competition in most cultivated varieties of tomato is most critical between transplanting and 6WAT in Nigeria.

Tomato fruit yield were generally not significantly improved with subsequent weeding beyond 9WAT. In fact further weeding beyond this period seems to cause depression in tomato fruit yield in some cases. The depression caused by weeding beyond 9WAT may be attributed to possible damaging effect of frequent hoe-weeding on the crop particularly at the advanced stage of the crop growth when there was full canopy formation. A lot of injury might have been inflicted on the roots and brittle branches with the hoe during weeding, coupled with the possibility of shedding many flower buds and immature fruits with hoes in the process of weeding at the advanced stage of the crop growth. Olunuga and Akobundu (1980) have similarly observed that the traditional hoe weeding is not only streneous, labour-intensive and time-consuming but may also cause damage to the crop roots and stems with subsequent yield losses.

Weed infestation throughout the crop life-cycle resulted in about 40 to 60 % reduction in potential tomato fruit yield. Friesen (1979) observed that when weeds were allowed to remain in the crop for more than 24 days after transplanting, yield were progressively reduced, while Armelina (1983) reported a 72 to 92% loss in potential tomato fruit yield due to unchecked weed growth. Similarly in Nigeria, Sinha and Lagoke (1984) reported between 43 and 67% loss in potential tomato fruit yield due to unrestricted weed growth.

In conclusion, this study shows that the critical period of weed interference in

transplanted tomato was between 3 and 6 weeks after transplanting in both irrigated and rainfed transplanted tomatoes. This is in agreement with Usoroh (1983) who demonstrated that weed competition in most cultivated varieties of tomato is most critical in the first 6 weeks after transplanting. This period coincides with the time when weeds were most rapidly growing and having maximum competition with the crop, which does not have enough canopy for full ground cover. Hence adequate plan must be made to ensure effective weed control during the early stage of the crop growth in order to obtain optimum yield and good profitability.

REFERENCES

ADEJONWO, K.O. (1988). Effects of nitrogen, period of weed interference and chemical weed control on okra *(Abelmeschus esculentum* (L) Moench). Ph.D. Thesis Ahmadu Bellow University, Zaria,Nigeria. . 209 pp.

ADIGUN, J.A; LAGOKE, S.T.O. AND KARIKARI S.K. (1992). Weed interference in transplanted sweet peppers *(Capsicum annuum* (L.) *Samaru Journal of Agricultural Research* 9: 49-61.

ADIGUN, J. A. LAGOKE, S. T. O; KUMAR, V. AND ERINLE. I. D. (1993). Weed management studies in transplanted tomato in the Nigerian Savanna. Samaru Journal of Agricultural Research 10:29-39.

ALEGBEJO, M.D. (1987). Identification of a weed host of pepper veinal mottle virus in Northern Nigeria. *Sarnaru Journal of Agricultural Research,* 5:65- 70.

ARMELINA, A.O. (1983). Weed competition in direct sown tomatoes in the low Rio Negre Valley. *Maleza* 11: 142 -146.

BESTE, C.E. (1979). Yellow mutsedge competition in direct seeded tomatoes. *Proceedings North Eastern Weed Science Society.* Department of Hort. University ofMary land, College Park, 20742, United States of America, 33:107.

BLANCO, E.G. AND OLIVEIRA, H.D. (1971) Duration of competition period between weeds and carrot. *Biology Brazie* 37:3-7.

DADARI, S.A. (1983). Studies on weed competition and performance ofvarious herbicides under different sowing dates and nitrogen, levels in rainfed cotton (Gossypium *hirsutum* L.). MSc. Thesis. Ahmadu Bellow University, Zaria. 119 pp.

DOWSON, R. T. AND ROBERTS, H.A. (1973). Some effects ofweed competition in the growth ofonions, *Journal ofHost. Science* 48:51-57.

ERINLE, I.D. (1982). The potential for integrated pest management in Nigeria with special reference to tomato. *(Lycopersicon esculantum* Mill). *Proceedings 5th Annual ~onference Rort. Society of Nigeria.* Ahmad u Bello Univ. zaria- Nigeria : 62 - 71.

EVERAATS, A.P. AND MUCHTAR, T. (1979). Weed competition in dabbage of Java. *Proceeding 7th Asian Pacific Weed Science Society Conf.* Sydney, Australia: 83-86.

FRIESEN, G.R. (1979). Weed interference in transplanted tomatoes *(Lycopersion esculentum Mill). Weed Science* 27: 11-13.

LAGOKE, S. T.O. ADEJOUWO, K.O, NONGU, T. T. UWANNAH, C.E. AND LAWAL K.O (1988). Studies on weed interference and chemical. weed control in chilli pepper (Capsicum frutescens L.) *Nigerian Journal of Weed Science* 1:3-10.

NIETO, J; BRANDO, M.A. AND GONZAEZ, J.T. (1968). Critical. period of the crop growth cycle for competition from weeds. *Pest. Article and News Summary* 14: 159- 166.

OKAFOR, L.I. 1987. Weed competition and control in irrigated cotton in the Lake Chad Basin, Nigeria. *TroRical Pest Management* 33:13-15.

0LUNUGA, B.A. AND AKOBUNDU, 1.0 (1980). Weed problems and control in field and vegetable crops in Nigeria. *Proceedings of a conference held at lIT A Ibadan* July, 1978. Proc. Series 3. E.O. AkobunduEdT.

SANOK, W.J. SHELLECK, G.W. AND GREIGHTON J.F (1979) Weed control and phytotoxity with herbicides in five tomato varieties. *Proceedings of the North eastern weed science society*. Department of Rort. University of Maryland, College Park 20742, USA, 33:332-335.

SINHA T.O. AND LAGOKE S.T.O (1984). Weed control in irrigated tomato *(Lycopersicon esculentumnti/)* in Northern Nigeria. *TroRical Pest Management* 30: 1825.

USOROH, N.J. (1979). Assesment of the critical period of weed Competition in tomato (Lucopersicon esculentum Mill) *Proceedings of 9th Annual conference of weed science society of Nigeria.* University oflfe lle-Ife, Nigeria. 2- 4 Dec. 1977, 62-65.

USOROH, N.J (1983). Field screening of herbicides for weed control in tomatoes *(Lycopersicon esculentum* mill). Paper presented at the 13th Ran. Cof, Wed

Science society of Nigeria. National cereals Research Institute, Ibadan 5-8 Dec.

WEAVER, S.E (1985) Critical period of weed competition in three vegetable crops in relation to management practices *Weed Research* 24:313-325.

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Tab. 1. : Common weed species present at the experimental sites and their level of infestation

	Level of infestation			
	Samaru		Kadawa	
Weed species	**1989**	**1990**	**1987/88**	**1987/89**
A) Annual grasses				
Eleusine indica (L.) Gaertn	++	++	-	-
Digitaria ciliaris (Ret.) Kock	++	++	+	+
Cynodon dactylon (L.) Pers	+++	+++	++	++
Eragrostis tremular (L.)	+	+	+	+
Chloris pilosa (Schum.)	+	+	+	+
Dactyloctenium aegyptium (L.) Beauv.	++	+	-	-
Echinochloa colona (L.) Link	+	+	+	+
Brachiaria lata Hubb. (Schum.)	+	++	+	+
B) Broad-leaved weeds				
Acanthospermum hispidium DC.	+++	+++	+++	+++
Vernonia galanmensis (L.) Cass.) Less	++	++	++	++
Vernonia pauciflora (L.)	++	++	++	++
Amaranthus spinosus (L.)	++	++	++	++
Amaranthus viridis (L.)	+	+	+	+
Solanum nigrum (L.)	++	+	++	++
Solanum nodiflora (L.)	+	+	++	++
Ageratum conyzoides (L.)	+	+	+	+
Portulaca oleracea (L.)	++	++	++	++
C) Sedges				
Cyperus rotundus (L.)	++	+++		++
Cyperus esculentum (L.)	++	+++		++

+++ High infestation (60 – 90% occurrence ++ Moderate (40 – 59% occurrence)
+ Low infestation (10 – 39% occurrence) (presence not noticeable)

Tab. 2.: Effects of period of weed interference on weed dry matter transplanted tomato at Kadawa in 1987/88 dry season

Treatment	Cumulative weed weight at harvest (t/ha)	Crop vigour score (12 WAT)	No. of leaves per plant (12 WAT)	No of branches per plant	Tomato fruit yield Total fruit No. per plant	Fruit Weight (t/ha)
Period of weed interference						
Weed-free 3 WAT	17.50b[2]	5.33b	26.56c	9.17cd	25.22bcde	9.86de
Weed-free 6 WAT	13.86ab	6.06ab	31.17bc	10.89bc	24.17bcde	13.62bcd
Weed-free 9 WAT	9.64a	6.67a	42.94a	13.17ab	36.34bc	19.74a
Weed-free 12 WAT	11.53ab	6.67a	36.44ab	12.17ab	55.67a	18.98ab
Weed-free until harvest	11.08ab	-	-	-	39.22ab	17.02abc
Weed-infested for 3 WAT	11.28ab	7.17a	37.89ab	14.06a	35.6bcd	13.00cd
Weed-infested for 6 WAT	12.42ab	6.06ab	26.61c	9.39cd	17.11def	13.98abcd
Weed-infested for 9 WAT	21.42cd	3.72c	25.55c	7.39d	18.28cdef	10.32dc
Weed-infested for 12 WAT	29.31d	3.27c	15.22d	7.00d	14.72cf	6.22c
Weed-infested until harvest	32.78d	-	-	-	11.22f	9.22dc
SE (±)	2.00	0.36	2.38	0.79	5.60	1.94

Tab. 3.: Effect of period of weed interference on weed dry matter, growth and yield of transplanted tomato at Kadawa in 1988/89 dry season

Treatment	Cumulative weed weight at harvest (t/ha)	Crop vigour score (12 WAT)	No. of leaves per plant (12 WAT)	No of branches per plant	Tomato fruit yield Total fruit No. per plant	Fruit Weight (t/ha)
Period of weed interference						
Weed-free 3 WAT	16.69b2	7.34b	25.48b	8.19cd	21.93cd	24.75cde
Weed-free 6 WAT	16.78b	8.28ab	27.19b	9.59bc	21.89cd	34.40abc
Weed-free 9 WAT	8.65a	9.11a	37.37a	11.92a	29.26bc	40.95a
Weed-free 12 WAT	10.94a	9.39a	37a	11.41ab	43.96a	37.00abc
Weed-free until harvest	10.69a	-	-	-	35.15abc	33.90abc
Weed-infested for 3 WAT	11.67a	9.50a	34.15a	12.96a	34.44abc	31.80abc
Weed-infested for 6 WAT	11.26a	8.34ab	23.33bc	8.44cd	15.04d	27.55bcd
Weed-infested for 9 WAT	23.35a	5.40ab	18.63cd	6.93d	16.56d	20.75bcd
Weed-infested for 12 WAT	29.41d	4.61c	159d	66.78d	15.26d	13.40c
Weed-infested until harvest	28.85d	-	-	-	13.00d	23.40dc
SE (±)	1.61	0.43	1.86	0.61	4.09	3.83

1. WAT = Weeks after transplanting;
2. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability (DMRT)
3. – Treatment not completely applied at the time of observation.

Tab. 4.: Effect of period of weed interference on weed dry matter, growth and yield of transplanted tomato at Kadawa in 1989 wed season

Treatment	Cumulative weed weight at harvest (t/ha)	Crop vigour score (12 WAT)	No. of leaves per plant (12 WAT)	No of branches per plant	Tomato fruit yield Total fruit Fruit No. per plant	Weight (t/ha)
Period of weed interference						
Weed-free 3 WAT	17.36c	5.85c	50.22	6.33	7.92c	3.90c
Weed-free 6 WAT	10.74a	6.30bc	45.71	7.04	8.48bc	4.20bc
Weed-free 9 WAT	19.83c	7.50a	50.64	6.37	8.48bc	4.00bc
Weed-free 12 WAT	14.00b	6.90ab	55.80	-	10.00a	5.00a
Weed-free until harvest	9.33a	-	-	-	9.22ab	4.60a
Weed-infested for 3 WAT	17.50c	7.20ab	46.63	6.37	10.30a	5.20a
Weed-infested for 6 WAT	10.50a	6.00c	51.36	6.30	7.85bc	3.90
Weed-infested for 9 WAT	25.67d	4.50d	47.74	6.07	5.11d	2.40c
Weed-infested for 12 WAT	30.25c	3.69d	48.84	-	5.70d	3.00de
Weed-infested until harvest	29.17c	-	-	-	6.07d	3.00
SE (±)	0.91	0.32	2.99	0.34	0.42	0.21

Tab. 5.: Effect of period of weed interference on weed dry matter, growth and yield of transplanted tomato at Kadawa in 1988/89 dry season

Treatment	Cumulative weed weight at harvest (t/ha)	Crop vigour score (12 WAT)	No. of leaves per plant (12 WAT)	No of branches per plant	Tomato fruit yield Total fruit No. per plant	Fruit Weight (t/ha)
Period of weed interference						
Weed-free 3 WAT	10.11c	4.74c	40.26	5.37	8.83	7.12cd
Weed-free 6 WAT	5.33b	7.30a	37.37	5.82	10.19	10.87ab
Weed-free 9 WAT	5.33b	7.46a	40.89	5.04	8.66	11.19ab
Weed-free 12 WAT	5.94b	6.02b	35.26	-	9.62	9.30bc
Weed-free until harvest	5.33b	-	-	-	9.87	11.77a
Weed-infested for 3 WAT	3.33a	6.09ab	38.00	5.70	8.79	10.37ab
Weed-infested for 6 WAT	11.44d	4.48c	41.04	6.20	8.75	7.45cd
Weed-infested for 9 WAT	11.38d	3.96c	43.11	6.41	9.07	5.56cd
Weed-infested for 12 WAT	12.70c	4.08c	39.89	-	8.47	5.07e
Weed-infested until harvest	14.48f	-	-	-	8.41	4.70
SE (±)	0.27	0.31	2.73	0.40	0.70	0.62

1. WAT = Weeks after transplanting;
2. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability (DMRT)
3. – Treatment not completely applied at the time of observation.

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