Research Article

Evaluation of Different Herbicides on Weed Control, Yield and Quality of Sweet Orange

Shweta*, G. S. Rana, Anil Duhan and Amandeep Kaur

College of agriculture, CCSHAU, Hisar

Abstract

The low productivity is probably due to poor management like severe problems due to weeds and general negligence of orchards. Weeds have tremendous potential to compete with crops and orchard plants for natural resources. Mostly weeds have C4 mechanism, so that weeds can tolerate high range of temperature, fix more CO_2 in adverse conditions and also impact cultural operations, tree growth and yields by altering the spray pattern of low volume irrigation systems, intercepting soil- applied chemicals (fertilizer and agricultural chemicals), reducing grove temperatures during freeze events and interfering with pruning and harvest operations. There were 5 weed species identified which are belonging to 5 families. The residual effect of herbicides on fruits was observed that there is no residual effect of herbicides on fruits. During study it was observed that under weed free treatment maximum nitrogen content, which was 22.06 per cent higher to weedy plants leaves, while P and K content was maximum under Atrazine @2 kg /ha + Glyphosate @1.0 kg /ha treatment, which was 66.67 per cent P and 31.32 per cent K higher over to weedy treatments.

Keywords: Herbicides,sweet orange, weed control, weeds,net return, residual study

***Correspondence**

Author: Shweta

Email: malik.shweta54@gmail.com

Introduction

The total area under fruits was 7,865 ha with a total production of 27,527 MT during 1966-67, which had increased to 46,788 hectare area with production of 5.97 lakh M.T during 2015-16. Area under sweet orange is 2,44,000 ha with 34,68,000 MT production [1]. The Haryana state ranks 13th in citrus production, with main citrus growing district are Sirsa, Hisar, Ambala, Gurgaon and Fatehabad, which contributes around 45 % of total food production [2].

Lemon juice contains 5-6 % citric acid, which gives sour taste to lemon. Citric acid is one of the major sources of obtaining commercial grade citric acid. The d-limonene in lemon oil is used as a non-toxic insecticide treatment. Lemon juice is a highly effective antioxidant. It contains higher concentrations of the Vitamin C and also contains significant amounts of vitamin B such as thiamine, riboflavin and niacin. Lemon acts as a sedative for the nerves and the heart and allays troublesome palpitation. Lemon juice works as a natural hair lightener when applied on hairs.

Citrus orchards will be bearing fruits from 2-3 years after planting. During pre-bearing period usually farmers not receive any return from orchard. Mainly citrus planted at 5X5 or 6X6 m spacing. In India, the average yield of citrus is about 10 t/ha, which is quiet less than the citrus yield (20-25 t/ha) in other countries like Brazil, Spain, USA, Japan, China and Mexico. The low productivity is probably due to poor management like severe problems due to weeds and general negligence of orchards [3].

Weeds have tremendous potential to compete with crops and orchard plants for natural resources. Mostly weeds have C4 mechanism, so that weeds can tolerate high range of temperature, fix more CO_2 in adverse conditions and also impact cultural operations, tree growth and yields by altering the spray pattern of low volume irrigation systems, intercepting soil- applied chemicals (fertilizer and agricultural chemicals), reducing grove temperatures during freeze events and interfering with pruning and harvest operations. The presence of weeds in a citrus grove can also affect insect populations. Weeds growing around tree trunks may also create a favorable environment for pathogens that infect the trunk and roots [4]. Weed species compete with citrus trees in many ways and with varying intensities; management of more competitive weeds such as *Conyza canadensis*, *Conyza bonariensis*, *Sorghum helepense*, *Cyperus spp*., and *Vicia sativa* should be prioritized. While some weeds (e.g., *Tribulus terrestris*, *Xanthium spinosum*, *Cirsium vulgare* and *Helminthotheca echioides*) may have low competitive effects on citrus trees, they can hinder labor operations and may also rank high for active management. Tillage is an effective method of controlling annual weeds effectively by severing weed stems and roots but is can be counterproductive for perennial grasses or sedges that can propagate vegetative. Mechanical mowing is generally more expensive than tillage and can throw seed under the tree canopy, increasing weed pressure next to the tree trunk.

Herbicides applied too early, before weeds emerge, will not provide adequate weed control due to herbicide leaching or degradation mainly by rainfall or irrigation on the soil surface or within the soil profile. Pre-emergence herbicides must be incorporated and are usually broadcast on the entire orchard floor since growers do not know where weeds will emerge. Though continuous use over time will likely lead to the development of resistant populations in some weed species. Glyphosate is widely used systemic post emergence herbicides widely used in citrus due to its efficacy on many weed species and relatively low cost [5]. The eradication of weeds is very essential either by direct destruction or by prevention of multiplication. To prevent the spread of weeds, irrigation canals and ditch banks should be free of weeds or weed seeds.

Material and Methods

The experiment was carried out at the Horticulture Farm of CCSHAU, Hisar, Haryana which is situated at 29° 10' latitude, 75º 46' longitude and altitude of 215.2 m and with the aim to study the effect of different types of herbicides and mechanical method of weed control on sweet orange cv Jaffa orchard. The experiment was conducted in complete randomized block design with eight treatments which were replicated thrice. Weedy check, Weed free, Power weeder, Atrazine@ 2 kg /ha, Glyphosate @ 1.0 kg /ha Paraquat @ 0.75 kg /ha, Atrazine @ 2 kg /ha + Glyphosate @ 1.0 kg /ha, Atrazine @ 2 kg /ha + Paraquat @ 0.75 kg /ha. All the treatments apply twice in a year first one during Feb-March and second one during August- September. Initial soil pH 7.88 and EC 1.09 ds/m were recorded (1:2 ratios). The soil was sandy loam and annual rainfall is 450 mm, however most of the rainfall received during S-W monsoon season (July- Mid September). Weed count and dry matter taken from m^2 area with the help of quadrant at one month after treatment. All aboveground weed biomass was oven dried till constant weight occurs at 104^o C. Residual study of herbicides on fruits also taken after two years.

The leaf samples were collected and digested by the procedure suggested by [6]. Nitrogen was estimated by using Micro-Kjeldahl's method [7]. Phosphorus content in plant parts was determined by following spectrophotometry method [7]. Potassium content in plant parts was determined by using Flame photometric methods [7].

Results and Discussion

The results revealed that there were 5 weed species identified which are belonging to 5 families. The lavish growth of a large variety makes the consequences at poor weed control most damaging to citrus production. Weeds contend especially with young trees, for resources such as nutrients, water, light and space and also harbor insects and rodents that attack citrus trees. The competition often results in reductions of tree growth, leaf nitrogen level, water potential, fruit yield and quality.

The results revealed that main weeds were *Cyperus rotundus* (Nut sedge), *Cynodon dactylon* (Bermuda grass), *Chinopodium album* (Lamb's squarters), *Amaranthus spp* (Pig weed) and *Parthanium hyterophorus* (Carrot grass). Some unidentified weeds were kept under others weeds. Broad leaf weeds have maximum contribution (55.29 %), grassy weeds contribute (31.54%) and followed by others (14.37%) (**Figure 1**). When study the effect of different treatments on weed count observed that *Cyperus rotundus*, *Cynodon dactylon* and other weeds contributes 20-20 percent of total weeds; broad leaf weeds *Chinopodium album*, *Amaranthus spp* and *Parthanium* contributes 16.7, 13.3 and 10.0 per cent, respectively under weedy condition. After one and two month of spray it was recorded that higher number of weeds (26 and 25, respectively) after Atrazine spray over to other weed treatments. There is no effect of atrazine on *Cynodon dactylon* and very less effect on *Cyperus rotundus* after one month of spray. Glyphosate control over all more weeds after one month of spray and effect was more on broad leaves than to grassy weeds [8-12].

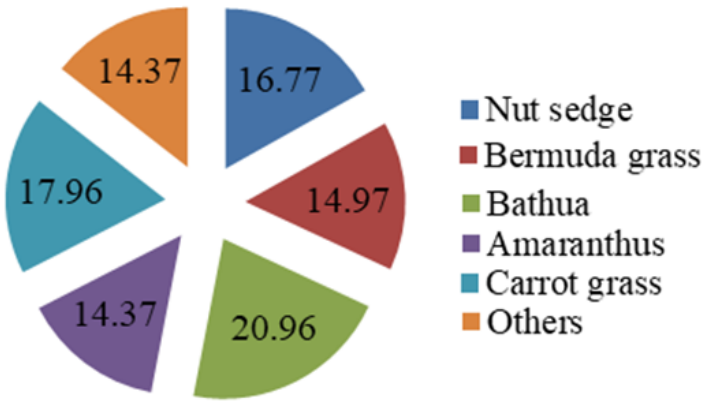

Figure 1 Per cent contribution of different weeds during study (mean of two years)

The maximum number of weeds/m^2, fresh weight and dry weight were observed under weedy check (37, 41.0, 25.0 g/m^{2}during Ist year and 37.5, 40.88 and 24.0 g/m^2, during IInd year respectively) (**Table 2**). Among the herbicides, minimum number of weeds/m^2 were observed in treatment T_7 Atrazine @ 2 kg/ha + Glyphosate @ 1.0 kg/ha (Table 2). The significantly higher number of fruits (198) was counted in weed free (T_2) over all other treatments, which was at par with each other except weedy check where significantly lower number of fruits (127.33) was observed during second year of study. The effect of treatments on fruit yield was non significant, but higher fruit yield was observed in weed free during both years. Similar results were reported by [12-14].

Table1 Weeds in citrus orchard during study

Scientific name	Family	Common name	Life cycle	Reproduction method
Amaranthus spp	Amaranthaceae	Pig weed	Annual	Seed
Chinopodium album	Chenopodiaceae	Lamb's squarters	Annual	Seed
Cyperus rotundus	Cyperaceae	Nut sedge	Perennial	Rhizome
Cynodon dactylon	Poaceae	Bermuda grass	Perennial	Rhizome
Parthanium spp	*Asteraceae*	Carrot grass	Annual	Seed

Table 2 Effect of different weed control methods on weeds of citrus orchard during study

S.N.	Treatments	No of weeds/m^2		Fresh weight (g/m^2)		Dry matter accumulation (g/m^2)	
		Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
T1	Weedy check	37.0(6.15)	37.5(6.19)	41.00(6.49)	40.88(6.46)	25.00(5.08)	24.0(4.98)
T2	Weed free	0.0(1.00)	0.0(1.00)	0.0(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)
T3	Power weeder	24.1(4.99)	24.6(5.03)	29.78(5.55)	30.38(5.60)	17.07(4.25)	16.40(4.17)
T4	Atrazine @2 kg /ha	27.2(5.31)	28.1(5.38)	25.80(5.17)	26.84(5.27)	14.67(3.94)	15.24(4.01)
T5	Glyphosate @1.0 kg /ha	21.8(4.77)	20.9(4.57)	20.10(4.20)	17.70(4.32)	6.84(2.80)	11.57(3.54)
T6	Paraquat @0.75 kg /ha	19.0(4.47)	18.5(4.41)	12.30 (3.63)	11.80(3.55)	6.60(2.75)	8.66(3.09)
T7	Atrazine @2 kg /ha + Glyphosate @1.0 kg /ha	18.0(4.36)	17.5(4.29)	12.80(3.71)	12.30(3.64)	7.18(2.87)	7.75(2.96)
T8	Atrazine @2 kg /ha + Paraquat @0.75 kg /ha	21.1 (4.69)	20.6(4.62)	11.72(3.57)	11.22(3.46)	7.11(2.84)	7.05(2.81)
CD at 5 %		0.59	0.69	0.46	0.66	0.47	0.55
original value in parenthesis							

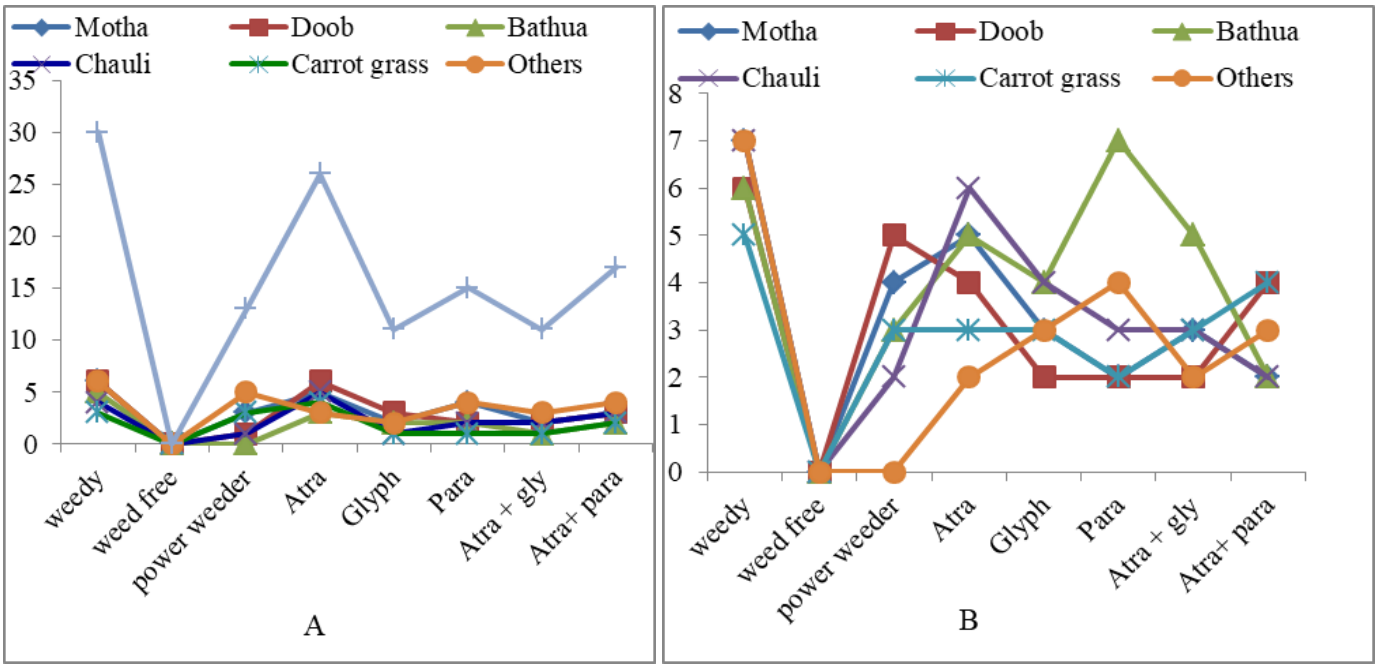

Figure 2 Weed count after one month (A) & two month (B) of spray. (Mean of two years)

The maximum fruit yield (24.0 & 23.33 kg/plant) was observed in Weed free (T_2) and followed by Atrazine @ 2 kg/ha + Paraquat @ 0.75 kg/ha (T_8) (23.76 & 22.76 kg/plant) respectively during first and second year of study. Fruit

quality (TSS and juice %) was not affected significantly by any of the treatment, however, maximum juice content was recorded in power weeder treatment (48.4 & 48.0 %) (Table 2). Economics was calculated and found that maximum cost of cultivation under weed free treatment. This was due to more labour charges. Maximum net return (Rs/acre) was recorded under Atrazine @ 2 kg/ha + Glyphosate @1.0 kg /ha followed by Paraquat @ 0.75 kg/ha and power weeder treatments (**Table 3**).

The residual effect of herbicides on fruits was observed that there is no residual effect of herbicides on fruits. Residues **(**µg/ml of fruit juice) are below detectable limit (BDL) in all the herbicides. The LOD (level of detection) 0.001 ppm for Atrazine, 0.01 ppm for glyphosate and 0.03 ppm for paraquat. During study it was observed that under weed free treatment maximum nitrogen content, which was 22.06 per cent higher to weedy plants leaves, while P and K content was maximum under Atrazine @2 kg /ha + Glyphosate @1.0 kg /ha treatment, which was 66.67 per cent P and 31.32 per cent K higher over to weedy treatments (**Figure 3**).

Table 3 Effect of different weed control methods on yield and yield attributes of sweet orange during study

Treatments	Yield kg/plant		No. of fruit/plant		Fruit weight (g)		Juice (%)		TSS (%)	
	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr	Ist yr	IInd yr
T1	19.16	18.83	191.0	127.33	150.6	133.33	47.3	46.9	9.54	9.2
T2	24.00	23.33	240.7	198.00	148.2	141.55	48.1	47.6	9.82	9.3
T3	22.41	21.74	190.7	157.33	157.2	142.56	48.4	48.0	9.93	9.7
T4	19.59	20.48	189.0	155.67	163.4	153.44	47.0	46.7	9.61	8.8
T5	22.77	22.10	196.3	163.00	149.0	140.00	44.4	43.8	10.01	9.3
T6	22.81	22.54	189.3	156.00	152.3	146.67	46.3	45.7	10.17	9.6
T7	23.33	22.66	201.3	168.00	150.9	139.33	47.3	46.7	9.47	8.9
T8	23.76	22.76	199.7	165.67	158.6	145.67	45.4	44.4	9.49	9.3
CD 5%	NS	NS	NS	25.53	NS	NS	NS	NS	NS	NS

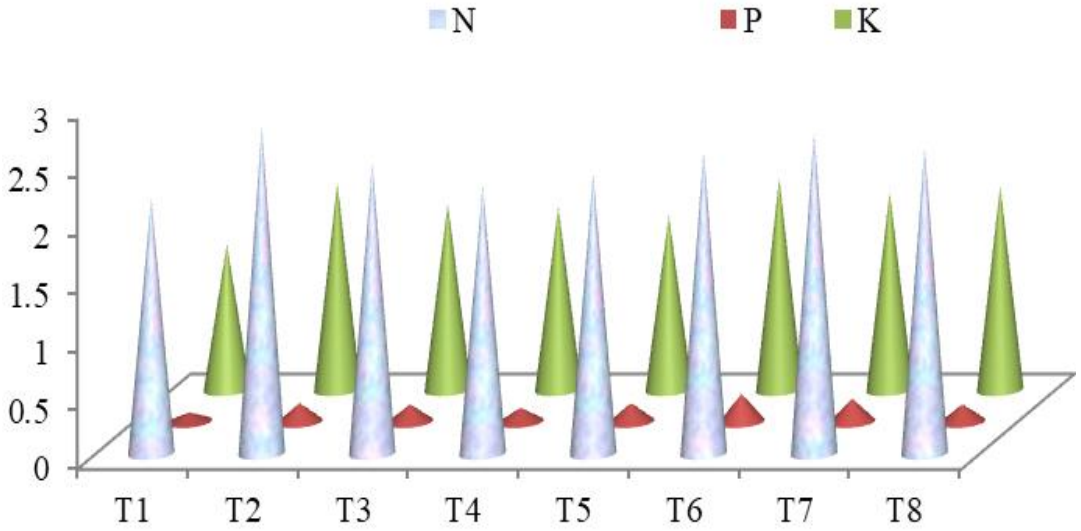

Figure 3 Effect of treatmentas on NPK content in leaves

Table 4 Economics of sweet orange with different weed control treatment (Mean of two year)

Treatments	Gross return (Rs/acre)	Cost of cultivation (Rs/acre)	Net return (Rs/acre)
T1	40320	42470	-2150
T2	51320	45670	5650
T3	47840	42870	4970
T4	45060	42650	2410
T5	48620	42615	6005
T6	49600	43050	6550
T7	49860	43035	6825
T8	50080	45470	4610
Due to poor plant canopy desirable yield 50-55 kg/plant could not be achieved			

Table 5 Residual study of herbicides on citrus fruits after two year study

Sr. No	Treatments	Residues (µg/ml of fruit juice)
1	Atrazine @ 2 kg /ha	BDL
2	Glyphosate @ 1.0 kg /ha	BDL
3	Paraquat @ 0.75 kg /ha	BDL
4	Atrazine @ 2 kg /ha + Glyphosate @ 1.0 kg /ha	BDL
5	Atrazine @ 2 kg /ha + Paraquat @ 0.75 kg /ha	BDL

(BDL: Below detactable limit LOD: Limit of detaction LOQ: Limit of quantification)
LOD (Atrazine): 0.001 ppm; LOD (Glyphosate): 0.01ppm; LOD (Paraquat): 0.03ppm
LOQ (Atrazine): 0.003 ppm; LOQ (Glyphosate): 0.03ppm; LOQ (Paraquat): 0.1ppm

References

[1] Annonymus, 2017. Department of economics and statistical analysis Haryamna.Economic survey of Haryana, 2016-17pp180
[2] Annonymus, 2005. National Horticulture Mission Action Plan for Haryana.
[3] Singh, A. R. and Singh, R. P. 1977. Effect of nitrogen on growth, yield and quality of Nagpur mandarin (Citrus reticulata Blanco). Haryana Journal of Horticulture Science. 6: 31-34.
[4] Futch, S.H. and Singh, M. (2000). Proc. of the Florida State Hort. Soc. 2000, vol. 113: 68-74.
[5] Sharma, S. D. and Singh, M. 2007. Effect of Timing and Rates of Application of Glyphosate and Carfentrazone Herbicides and Their Mixtures on the Control of Some Broad- leaf Weeds. Hort Sc ience, 42(5): 1221-1226.
[6] Chapman, H. D. (1964) Suggested foliar sampling and handling techniques for determining nutrient status of some field, Horticultural and Plantation Crops. Indian J. Horti. 21: 98-118
[7] Jackson, M. L. 1973. Soil chemical analysis Prentice Hall PVT Ltd., India.
[8] Kaur, Nirmaljit and Rattanpal, H.S. 2017. Weed management in citrus orchards. RASHTRIYA KRISHI 12 (1) June, pp122-122
[9] Barbora, A. C., Borah, S. C. and Bhattacharya, D. 2002. Effect of weed management on yield and quality of Khasi mandarin (Citrus reticulate Blanco). Indian J. Citricult. 1:62–65
[10] Martini, G., Pedrinho, A. F. A., Jr, G. V., Felici, F. M., Piva, and Durggan, J.C. 2002. Efficacy of a new formulation of glyphosate for control of bermuda grass (Cynodon dactylon) in citrus orchards. Revista Brasileira de Fruticultura 24:683–686.
[11] Sabbah, S. M., Assal, A. T.and Ghaly, E. A. 1994. The relative influence of some herbicides (trifluralin, glyphosate, and bromacil) on yield, fruit quality, and leaf mineral composition of Washington navel orange trees. Ann. Agr. Sci. (Egypt) 39:721–729.
[12] Singh, S. and Singh, M. 2004. Effect of growth stage on trifloxysulfuron and glyphosate efficacy in twelve weed species of citrus groves. Weed Technol. 18:1031–1036.
[13] Santinoni, L. A. and Silva, N. A. 1995. Growth, yield, and maturation of common mandarin under different soil management practices. Horticultura Argenteina 14:5–11 (Weed Abst.1996, 45:3233).
[14] Lima, A., De, A., Caldas, R. C., Borges, A. L., Ritzinger, C. H. S. P., Trindale, A. V., De, M., Pires, M., Midlej, M. M. B. C., Mata, H. T. D. A. C. and. Souza, J. D. A. S. 2002. Intercropping and weed control in yellow passion fruit orchards. Revista Brasileira de Fruticultura 24:711–713.

Publication History
Received 23rd Mar 2018
Revised 20th Apr 2018
Accepted 09th May 2018
Online 30th May 2018