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## Performance of pre and post emergence herbicides on nutrient removal and uptake in tomato cv. Arka vikas

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### Abstract

A field experiment was conducted to study the performance of pre and post emergence herbicides on nutrient removal and Uptake in Tomato cv. Arka vikas during rabi 2011-12 and 2012-13. The experiment consisted of 10 treatments of Pre and post emergence herbicides (Pendimethalin, Oxyflourfen, Imazethapyr and Quizalofop ethyle) and their combinations which were replicated in Randomized block design. All the weed control treatments significantly influenced nutrient removal by weeds and Nutrient uptake by tomato plants. Pre emergence herbicides coupled with Quizalofop ethyle found to be on par with Hand weeding. Though Imazethapyr applied as post emergence effectively controls the weeds but found to be extremely toxic to the crop. The maximum yield of tomato was recorded with Hand weeding, which is on par with the application of pre emergence herbicides combined with Quizalofop ethyle @ 75g a.i per ha.

**Keywords:** Pendimethalin, oxyflourfen, imazethapyr, quizalofop ethyle, nutrient removal and uptake

### Introduction

Tomato (*Solanum lycopersicon*, L.) is one of the most popular and widely grown vegetables in the world, ranking second in importance to potato in many countries. The fruits are eaten raw or cooked. Tomato supplies vitamin C and add variety of colours and flavours to the foods. Tomato is also rich in medicinal value. The pulp and juice are digestible, promoter of gastric secretion and blood purifier. It is also considered to be intestinal antiseptic. It is one of the richest vegetables which keeps our stomach and intestine in good condition. At present, the production share of tomato is 11.2 per cent of the total vegetable production with 9.6 percent of the total vegetable area in the country. In India it is being grown in an area of 8.7 lakh hectares with a production of 182.2 lakh tonnes and the productivity is 20.7 tonnes per hectare. Andhra Pradesh is leading state in tomato production, it accounts 28.63 percent of total tomato production in India. In Andhra Pradesh it is cultivated in an area of 2.60 lakh hectares with a production of 52.18 lakh tonnes and the average productivity is 20 tonnes per hectare. (Indian Horticultural Database, 2013) <sup>[1]</sup> Tomato being a cash vegetable crop brings good income to farmers and particularly around big cities. Weeds in tomato pose a serious problem and as such weed competition is severe during early stages of the crop. Wider spacing, frequent irrigations and liberal use of manures and fertilizers in the cultivation of tomato provide favourable conditions for the luxuriant weed growth particularly during early stages of the crop (Govindra Singh *et al.*, 1984) <sup>[2]</sup>. Manual weeding is a common practice and herbicides are hardly used for the purpose. Hence, commonly used herbicides can find a place in vegetable cultivation. Therefore the present investigation was undertaken to find out the performance of pre and post emergence herbicides alone and their combination on nutrient removal by weeds and nutrient uptake by the tomato crop.

### Material and Methods

An experiment was conducted at Horticultural college and Research Institute, Dr. Y.S.R Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari District, A.P during Rabi season of 2011-12 and 2012-13. The experimental farm is situated at 16.83°N latitude and 81.5°E longitude. The soil was acidic in reaction and medium in NPK availability. The texture of the soil was sandy loam. The experiment was laid out in Randomised block

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design with three replications in a plot size of 4X3 m<sup>2</sup>. The seeds of Tomato cultivar "Arka vikas" was sown for nursery raising and transplanting was done on ridge and furrow system by adopting spacing of 60X45 cm. The ten treatments consists of T<sub>1</sub>- Pendimethalin @ 0.75 Kg a.i / ha as pre emergence application, T<sub>2</sub>- Oxyfluorfen @ 0.125 Kg a.i / ha as pre emergence application, T<sub>3</sub>- Imazethapyr @ 100 g a.i / ha as post emergence application (20 DAT), T<sub>4</sub>- Quizalofop ethyl @ 75 g a.i / ha as post emergence application (20 DAT), T<sub>5</sub>- Pendimethalin @ 0.75 Kg a.i / ha as pre emergence application + Imazethapyr @ 100 g a.i / ha as post emergence application (20 DAT), T<sub>6</sub>- Pendimethalin @ 0.75 Kg a.i / ha as pre emergence application+ Imazethapyr @ 100 g a.i / ha as post emergence application (20 DAT), T<sub>7</sub>- Oxyfluorfen @ 0.125 Kg a.i / ha as pre emergence application + Quizalofop ethyl @ 75 g a.i / ha as post emergence application (20 DAT),

T<sub>8</sub>- Oxyfluorfen @ 0.125 Kg a.i / ha as pre emergence application + Quizalofop ethyl @ 75 g a.i / ha as post emergence application (20 DAT), T<sub>9</sub>- Weed free (Hand weeding) and T<sub>10</sub>- Weedy check. Twenty five days old seedlings were used for transplanting. All the package of practices to raise the good crop was done in the experimental field and weed control treatments applied as per the treatments. Observations such as Nutrient (NPK) removal by weeds (kg. ha<sup>-1</sup>) and Nutrient (NPK) uptake (kg. ha<sup>-1</sup>) by crop plants and fruit yield (t ha<sup>-1</sup>) were recorded.

## Results and Discussion

**Nutrient removal by weeds:** The data on nutrients like Nitrogen, Phosphorus and Potassium removed by weeds was significantly influenced by different weed management practices and the data are presented in the Table-1.

**Table 1:** Removal of Nitrogen (kg ha<sup>-1</sup>) by weeds at different growth stages of Tomato as influenced by weed management practices

Treatment	Nitrogen (kg ha <sup>-1</sup> )				Phosphorus (kg ha <sup>-1</sup> )				Potassium (kg ha <sup>-1</sup> )			
	60 DAT		90 DAT		60 DAT		90 DAT		60 DAT		90 DAT	
	2011-2012	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
T <sub>1</sub> Pendimethalin @ 0.75 kg a.i / ha as PE	7.94	7.52	30.84	27.23	2.16	2.23	2.45	2.48	9.38	10.36	34.61	33.36
T <sub>2</sub> Oxyfluorfen @ 0.125 kg a.i / ha as PE	7.86	7.36	29.70	25.66	2.12	2.15	2.22	2.24	10.14	9.53	32.62	31.14
T <sub>3</sub> Imazethapyr @ 60 g a.i / ha as POE (20 DAT)	13.37	14.93	43.75	40.47	3.45	3.41	4.13	4.15	16.31	15.23	47.95	47.27
T <sub>4</sub> Quizalofop ethyl @ 75 g a.i / ha as POE (20 DAT)	8.16	7.74	32.49	28.18	2.63	2.65	2.94	2.86	12.83	11.58	35.68	34.27
T <sub>5</sub> Pendimethalin @ 0.75 kg a.i / ha as PE + Imazethapyr @ 60 g a.i / ha as POE (20 DAT)	11.78	13.17	42.68	39.19	3.36	3.32	3.95	3.87	15.71	14.46	44.91	46.38
T <sub>6</sub> Pendimethalin @ 0.75 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE (20 DAT)	6.69	6.35	26.92	22.64	1.57	1.65	1.88	1.86	7.69	7.85	29.54	26.59
T <sub>7</sub> Oxyfluorfen @ 0.125 kg a.i / ha as PE + Imazethapyr @ 60 g a.i / ha as POE (20 DAT)	10.08	9.84	41.26	35.58	3.12	3.25	3.71	3.62	13.78	13.27	43.57	44.63
T <sub>8</sub> Oxyfluorfen @ 0.125 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE (20 DAT)	5.04	5.13	25.30	20.79	1.25	1.36	1.52	1.49	6.76	5.73	27.03	24.06
T <sub>9</sub> Weed free (Hand weeding at 20, 40 and 60 DAT)	4.67	4.85	20.53	18.32	1.16	1.13	1.21	1.23	5.47	5.18	22.29	20.38
T <sub>10</sub> Weedy Check	18.54	17.63	48.37	45.93	3.84	3.78	4.57	4.36	19.25	18.94	56.16	57.48
S.Em±	1.02	0.83	2.89	2.16	0.21	0.25	0.24	0.24	0.96	0.95	2.60	2.95
CD (P=0.05)	3.05	2.49	8.65	6.45	0.63	0.74	0.69	0.71	2.88	2.83	7.76	8.76

PE- Pre emergence

POE- Post emergence

DAT- Days after Transplanting

**Nitrogen removal by weeds:** The quantity of nitrogen removal by weeds increased with the age of crop. The nitrogen depletion by weeds was maximum under weedy check (T<sub>10</sub>) during both the years of experimentation. Depletion of nitrogen by weeds was significantly low under weed free condition T<sub>9</sub> (Hand weeding at 20, 40 and 60 DAT) and plots treated with pre emergence herbicides Pendimethalin @ 0.75 kg a.i/ha and Oxyfluorfen @ 0.125 kg a.i/ha coupled with Quizalofop ethyl @ 75 g a.i/ha as POE resulted in increase the nitrogen absorption by crop. At 19 DAT, depletion of nitrogen by weeds was found to be the lowest in T<sub>8</sub> (Oxyfluorfen @ 0.125 kg a.i/ha (PE) + Quizalofop ethyl @ 75g a.i/ha POE) treatment, which was statistically significant over T<sub>9</sub> (weed free-hand weeding at 20, 40, & 60 DAT), T<sub>10</sub> (weedy check), T<sub>3</sub> (Imazethapyr @ 60g a.i/ha as POE) and T<sub>4</sub> (Quizalofop ethyl @ 75 a.i/ha as POE). Minimum values of nitrogen removal were recorded with T<sub>9</sub> (weed free-hand weeding at 20, 40, & 60 DAT), at 60 DAT and 90 DAT. T<sub>9</sub> (weed free-hand weeding at 20,40& 60 DAT) was found to be statistically on par with T<sub>8</sub> (Oxyfluorfen @ 0.125 kg a.i/ha (PE) + Quizalofop ethyl @ 75g a.i/ha POE), T<sub>6</sub> (Pendimethalin @ 0.75 kg ai /ha (PE) + Quizalofop ethyl @ 75 g a.i/ha as POE), T<sub>2</sub>(Oxyfluorfen @ 0.125 kg a.i/ha as PE), T<sub>1</sub>(Pendimethalin @ 0.75kg a.i/ha as PE)at 30 DAT, while T<sub>9</sub> (weed free-hand weeding at 20, 40

and 60 DAT) was comparable with T<sub>8</sub> (Oxyfluorfen @ 0.125 kg a.i/ha (PE) + Quizalofop ethyl @ 75g a.i/ha POE), and T<sub>6</sub> (Pendimethalin @ 0.75 kg ai /ha (PE) + Quizalofop ethyl @ 75 g a.i/ha as POE), at 60 DAT and 90 DAT.

Due to phytotoxicity of imazethapyr to Tomato @ 60g a.i/ha, the biomass of weeds substantially increased at 60 and 90 DAT, resulting more depletion of nutrients by weeds in T<sub>3</sub> (imazethapyr @ 60g a.i/ha as POE) followed by T<sub>5</sub>(Pendimethalin @ 0.75 kg a.i / ha as PE+ Imazethapyr @ 60 g a.i / ha as POE), and T<sub>7</sub> (Oxyfluorfen @ 0.125 kg a.i / ha as PE + Imazethapyr @ 60 g a.i / ha as POE).

## Phosphorus removal by weeds

The treatment T<sub>9</sub> (weed free-hand weeding at 20, 40, & 60 DAT) was found to be lowest in phosphorus removal by weeds at 30 DAT, 60 DAT and 90 DAT, which was statistically on par with T<sub>8</sub> (Oxyfluorfen @ 0.125 kg a.i/ha (PE) + Quizalofop ethyl @ 75g a.i/ha POE) and T<sub>6</sub> (Pendimethalin @ 0.75 kg ai /ha (PE) + Quizalofop ethyl @ 75 g a.i/ha as POE), At 19 DAT minimum values was recorded with T<sub>8</sub>, which was significantly differed with T<sub>10</sub> (weedy check), T<sub>9</sub> (weed free-hand weeding at 20, 40, & 60 DAT), T<sub>3</sub> (Imazethapyr @ 60g a.i/ha as POE) and T<sub>4</sub>(Quizalofop ethyl @ 75 a.i/ha as POE). Maximum values

for removal of phosphorus were observed with T10 (weedy check) treatment during all stages of crop growth.

### Potassium removal by weeds

The minimum values in potassium removal was recorded in T9 (weed free-hand weeding at 20, 40, & 60 DAT), which found to be on par with T8(Oxyfluorfen @ 0.125 kg a.i/ha (PE) + Quizalofop ethyl @ 75g a.i/ha POE) and T6(Pendimethalin @ 0.75 kg ai /ha (PE) + Quizalofop ethyl @ 75 g a.i/ha as POE) treatments. In contrast highest values in potassium removal was observed with T10 at all stages of crop growth. The results of present investigation are also in agreement with the findings reported by Rana and Barewadia (1995) [3] and Saravanane and Kandasamy (2002) [4].

### Nutrient (NPK) uptake by tomato plants (kg ha<sup>-1</sup>)

The data recorded on nutrient uptake as influenced by the weed management practices are presented in Table-2. Significant differences were observed among weed

management practices for the nutrient uptake by crop plants. Among weed management practices, except T3 (Imazethapyr @ 60 g a.i/ ha as POE), T5(Pendimethalin @ 0.75 kg a.i / ha as PE + Imazethapyr @ 60 g a.i / ha as POE)all the treatments and T7 (Oxyfluorfen @ 0.125 kg a.i / ha as PE Imazethapyr @ 60 g a.i / ha as POE) recorded maximum N, P and K uptake by crop plants over weedy check (T10). Highest NPK uptake by crop plant was registered with T9 (Weed free - Hand weeding at 20, 40 and 60 DAT), during both the years of experiment. T9 (Weed free -Hand weeding at 20, 40 and 60 DAT) treatment exhibited highest nutrient uptake which was statistically on par with T8 (Oxyfluorfen @ 0.125 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE) in the absorption of nitrogen, phosphorus and potassium.

Lowest uptake of NPK by the crop was observed with T3 (Imazethapyr @ 60 g a.i / ha asPOE) which was statistically on par with T5(Pendimethalin @ 0.75 kg a.i / ha as PE +Imazethapyr @ 60 g a.i / ha as POE) and T7 (Oxyfluorfen @ 0.125 kg a.i / ha as PE Imazethapyr @ 60 g a.i / ha as POE).

**Table 2:** Nutrient (NPK) Uptake (Kg ha<sup>-1</sup>) by the Tomato plants as influenced by weed management practices

	Treatment	Nitrogen (Kg ha <sup>-1</sup> )		Phosphorus (Kg ha <sup>-1</sup> )		Potassium (Kg ha <sup>-1</sup> )		Yield (t/ha)	
		2011-2012	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
T <sub>1</sub>	Pendimethalin @ 0.75 kg a.i / ha as PE	58.12	51.53	10.66	7.79	63.23	56.89	18.52	20.24
T <sub>2</sub>	Oxyfluorfen @ 0.125 kg a.i / ha as PE	60.5	53.02	11.56	8.76	65.56	60.96	18.87	20.86
T <sub>3</sub>	Imazethapyr @ 60 g a.i / ha as POE (20 DAT)	21.51	15.52	6.13	4.55	22.95	17.43	3.88	3.78
T <sub>4</sub>	Quizalofop ethyl @ 75 g a.i / ha as POE (20 DAT)	53.58	44.56	9.54	6.57	54.73	52.22	16.92	17.84
T <sub>5</sub>	Pendimethalin @ 0.75 kg a.i / ha as PE +Imazethapyr @ 60 g a.i / ha as POE (20 DAT)	19.65	17.65	6.62	5.04	22.54	18.98	4.25	4.13
T <sub>6</sub>	Pendimethalin @ 0.75 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE (20 DAT)	79.34	77.54	13.85	11.25	75.23	66.86	21.59	23.42
T <sub>7</sub>	Oxyfluorfen @ 0.125 kg a.i / ha as PEImazethapyr @ 60 g a.i / ha as POE (20 DAT)	23.42	19.86	5.67	4.02	25.98	21.92	4.66	4.59
T <sub>8</sub>	Oxyfluorfen @ 0.125 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE (20 DAT)	83.23	81.68	14.67	11.82	89.91	84.84	21.98	23.91
T <sub>9</sub>	Weed free (Hand weeding at 20, 40 and 60 DAT)	86.35	84.36	15.75	12.96	93.62	90.31	26.50	29.20
T <sub>10</sub>	Weedy Check	26.75	21.66	7.08	5.32	30.82	25.54	12.85	13.24
	S.Em±	2.91	2.48	0.82	0.66	3.14	2.52	1.38	1.16
	CD (P=0.05)	9.85	7.42	2.46	1.95	9.32	7.55	4.12	3.46

PE- Pre emergence

POE- Post emergence

DAT- Days after Transplanting

Tomato plants in the treatment T9(weed free-hand weeding at 20, 40 & 60 DAT), registered highest nutrient uptake followed by T8 (Oxyfluorfen @ 0.125kg a.i/ha + Quizalofop ethyl @ 75g a.i/ha) and T6 (Pendimethalin @ 0.75kg a.i/ha + Quizalofop ethyl @ 75 a.i/ha). This might be due to minimum weed competition throughout the crop period, which facilitated higher dry matter production, resulting in higher nutrient uptake by the crop. Tomato crop in plots treated with imazethapyr @ 60g a.i/ha had lowest values of uptake of NPK nutrients due to phytotoxicity effect resulting in lower dry matter production. Tomato crop left weedy under weedy check (T10) registered lower values of nutrient uptake due to higher weed infestation and maximum utilization of resources by weeds rather than crops. Similar results were observed by Rana and Barevadia (1995) [3] and Sarvanane and Kandasamy (2002) [4].

### Fruit yield (t ha<sup>-1</sup>)

All the weed control treatments significantly influenced the fruit yield of tomato and the data are presented in the Table-2. All the weed management practices except T3 (Imazethapyr @ 60 g a.i / ha as POE), T5(Pendimethalin @ 0.75 kg a.i / ha as PE + Imazethapyr @ 60 g a.i / ha as POE) and T7

(Oxyfluorfen @ 0.125 kg a.i / ha as PE Imazethapyr @ 60 g a.i / ha as POE) produced significantly higher yield of tomato per ha over T10 (weedy check).

Among the treatments, maximum fruit yield of tomato per ha was recorded in T9 (Weed free -Hand weeding at 20, 40 and 60 DAT) treatment which was statistically on par with T8 (Oxyfluorfen @ 0.125 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE).

Treatments T6 (Pendimethalin @ 0.75 kg a.i / ha as PE + Quizalofop ethyl @ 75 g a.i / ha as POE), T1(Pendimethalin @ 0.75 kg a.i / ha as PE), T2 (Oxyfluorfen @ 0.125 kg a.i / ha as PE) and T4 (Quizalofop ethyl @ 75 g a.i / ha as POE) produced significantly higher yield over weedy check (T10) during both the years of study. Significantly lower yield in weedy check may be due to severe competition for plant nutrients, water and light between crop and weeds. Similar results were also reported by Balraj Singh (1994), Ram *et al.* (1994), Muniyappa *et al.*(1995), Tumbare and Ilhe (2004) and Warade *et al.* (2008) [6, 5, 7, 8, 9].

T3 (Imazethapyr @ 60 g a.i / ha as POE), T5(Pendimethalin @ 0.75 kg a.i / ha as PE+Imazethapyr @ 60 g a.i / ha as POE) and T7 (Oxyfluorfen @ 0.125 kg a.i / ha as PE Imazethapyr @ 60 g a.i / ha as POE) produced lower fruit yield than weedy

control during both the years of study. Among the three treatments, lowest fruit yield was recorded in T3, however it remained on par with T5 (Pendimethalin @ 0.75 kg a.i / ha as PE+ Imazethapyr @ 60 g a.i / ha as POE) and T7 (Oxyfluorfen @ 0.125 kg a.i / ha as PE Imazethapyr @ 60 g a.i / ha as POE).

### Conclusion

Application of Pre emergence herbicides such as Pendimethalin @ 0.75 kg a.i / ha and Oxyfluorfen @ 0.125 kg a.i / ha coupled with Quizalofop ethyle found to be on par with Hand weeding in good amount of nutrients (NPK) uptake by crop plants and low levels of nutrient removal by the weeds as they are effective in controlling weeds.

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