

## Bioefficiency of Oxyfluorfen (23.5% EC) on Weed Control in Groundnut and Its Effect on Soil Microorganism

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**Abstract** Field experiments were conducted for two years to evaluate the new formulation of oxyfluorfen (23.5% EC) on weed control in groundnut. The yield of groundnut crop depends upon various agronomic management practices. One of the major factors responsible for low productivity of groundnut is the problem of weeds. Based on two years field experimentation, it was found that pre-emergence application of oxyfluorfen (23.5% EC) at 400 g ha<sup>-1</sup> gave significantly lower total weed density, weed dry weight and higher weed control efficiency at all the intervals. Application of new formulation of oxyfluorfen (23.5% EC) at 250 g ha<sup>-1</sup> as pre-emergence herbicide can keep the weed density and dry weight below the economic threshold level and increase the pod yield (2058 and

2042 kg ha<sup>-1</sup>) in groundnut. Application of new formulation of oxyfluorfen (23.5% EC) did not left any adverse effect on the soil microflora after few days/months of their application during both the years.

**Keywords** Pod yield, Weed index, Soil microorganism.

### Introduction

Groundnut or peanut (*Arachis hypogaea* L.) is known as the *king* of oilseeds. It is one of the most important food and cash crop of our country. Groundnut is also called as wonder nut and poor men's cashew nut. Being a leguminous crop, groundnut is often included in crop rotation as it synthesizes atmospheric nitrogen and adds about 100–120 kg N ha<sup>-1</sup> season<sup>-1</sup> in the field. Weeds are considered as a major biotic constraint for high production. They compete with crops for light, nutrients, water, space and acts as hosts of several harmful insects and pathogens. The weeds which germinate before or simultaneously with the crop are frequently capable of forming a leaf canopy over crop. Groundnut cannot compete effectively with weeds, particularly 3–6 weeks after sowing and therefore, early removal of weeds is important before flowering and during pegging [1]. Groundnut being a short stature, initially slow growing crop, needs weed free condition throughout the crop growth period. Pod yield of groundnut is reduced by 70% if cover by weeds is more than 50%. The present investigation was therefore conducted to study the integrated ef-

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**Table 1.** Effect of weed management methods on pod yield and weed index of groundnut.

Treatments	kharif 2009			kharif 2010		
	Kernal weight (g)	Pod yield (kg ha <sup>-1</sup> )	Weed index (%)	Kernal weight (g)	Pod yield (kg ha <sup>-1</sup> )	Weed index (%)
T <sub>1</sub> -PE oxyfluorfen (Goal) at 200 g a.i ha <sup>-1</sup>	39.76	12540	21.33	39.44	12650	18.96
T <sub>2</sub> -PE oxyfluorfen at 1550 g a.i ha <sup>-1</sup>	39.42	13860	17.69	39.10	13530	15.18
T <sub>3</sub> -PE oxyfluorfen at 200 g a.i ha <sup>-1</sup>	40.18	15940	0.00	39.86	15610	0.00
T <sub>4</sub> -PE oxyfluorfen at 250 g a.i ha <sup>-1</sup>	40.56	15120	5.40	40.24	15090	3.14
T <sub>5</sub> -PE oxyfluorfen at 300 g a.i ha <sup>-1</sup>	39.21	14250	10.60	38.89	14050	9.99
T <sub>6</sub> -PE oxyfluorfen at 400 g a.i ha <sup>-1</sup>	39.08	13760	18.01	38.76	13830	11.40
T <sub>7</sub> -Pendi. at 0.75 kg ha <sup>-1</sup> + HW on 45 DAS	39.27	13180	16.69	38.95	13220	13.32
T <sub>8</sub> -Pendi. at 0.75 kg ha <sup>-1</sup> + RW on 45 DAS	39.13	12940	19.51	38.81	12730	18.45
T <sub>9</sub> -HW twice on 25 and 45 DAS	40.42	12880	10.16	40.10	14680	5.96
T <sub>10</sub> -Unweeded control	39.00	6280	60.60	38.68	6840	56.18
SEd	1.80	688	–	1.53	712	–
CD (P=0.05)	NS	1384	–	NS	1432	–

fect of different weed control treatments on weeds, soil micro-organisms, growth and development of groundnut.

## Materials and Methods

### Experimental site and initial soil characteristics

Field experiments were laid out during *kharif* seasons of 2009 and 2010 in North Block Farm of Agricultural Research Station (ARS), Bhavanisagar, located at Western Zone of Tamil Nadu. The geographical location of the experimental site is 11°29′ N latitude and 77°08′ E longitude with an altitude of 256 m above MSL and the farm receives the normal total annual rainfall of 696 mm in 42 rainy days. The soil of experimental site was well drained red sandy loam in texture (19.98% clay, 9.89% silt, 32.44% fine sand and 37.68% coarse sand) with low in available nitrogen, medium in available phosphorus and high in available potassium. The soil analyzed 241.00, 17.45 and 257 kg ha<sup>-1</sup> of KMnO<sub>4</sub>-N, Olsen-P and NH<sub>4</sub>OAc-K, respectively with EC of 0.19 dSm<sup>-1</sup>, pH of 6.9 and organic carbon of 0.54%.

### Experimental design, selection of cultivar and sowing

The experiment was laid out in randomized block de-

sign (RBD) with ten treatments and replicated thrice. The gross plot and net plot size adopted was 30.00 m<sup>2</sup> (6.0 m × 5.0 m) and 21.28 m<sup>2</sup> (5.6 m × 3.8 m). Irrigated groundnut variety VRI 2 maturing in 100–105 days. The seeds of groundnut were treated with *Trichoderma viride* at the rate of 2 g kg<sup>-1</sup> of seed. The recommended seed rate of 125 kg ha<sup>-1</sup> was adopted. Seeds sown during first week of June 2009 and 2010 in lines at 30 cm apart and 10 cm between plants. After sowing the seeds, immediately a light irrigation was given to the crop for uniform germination.

### Treatment details

Treatments consisted of pre-emergence application of already registered oxyfluorfen (goal) at 200 g ha<sup>-1</sup>, new formulation of oxyfluorfen (23.5% EC) at 150, 200, 250, 300 and 400 g ha<sup>-1</sup>, pendimethalin 0.75 kg ha<sup>-1</sup> + Hand weeding on 45 DAS, pendimethalin 0.75 kg ha<sup>-1</sup> + Rotary weeding on 45 DAS, Hand weeding twice on 25 and 45 DAS and unweeded check. The herbicides as per the treatment schedule were applied as pre-emergence at third day after sowing followed by a hand weeding on 45 DAS. Hand operated knapsack sprayer fitted with a flat fan type nozzle (WFN 40) was used for spraying the herbicides adopting a spray volume of 500 liters ha<sup>-1</sup>. For mechanically weeded plots, one weeding was given on 45 DAS with rotary weeder in between rows and the weeds within the rows were removed manually.

### Weed index

Weed index (WI) was calculated as per the method [2].

$$WI = \frac{X - Y}{X} \times 100$$

Where, X=yield (kg ha<sup>-1</sup>) from minimum weed competition plot,

Y=yield (kg ha<sup>-1</sup>) from the treatment plot for which WI is to be worked out.

### Microbial analysis

Population dynamics of different types of microorganisms in soil samples were collected at periodical intervals of 7, 15, 30, 45 and 60 DAHS (days after herbicide application) from groundnut trial. Soil samples were serially diluted up to a desired level and unless otherwise mentioned, 100 µ ml suspensions was added to 15–20 ml of the desired medium separately and plated in three petri plates. The plates were incubated at room temperature generally for 3 to 7 days and the number of colonies was counted.

### Statistical analysis

The data collected for groundnut were statistically analyzed by following procedure for randomized block design [3]. The data pertaining to weeds and germination were transformed to square root scale of  $\sqrt{(X + 2)}$  and analyzed [4]. Whenever significant difference existed, critical difference was constructed at five per cent probability level. Such of those treatments where the difference are not significant were denoted as NS.

## Results and Discussion

### Predominant weed flora in the experimental field

Weed flora of the experimental field in groundnut was predominantly consisted of nine species of broad leaved weeds, five species of grasses and a sedge

weed. The dominant grassy weed species were *Cynodon dactylon*, *Acrachne racemosa* and *Dactyloctenium aegyptium*. Among the broad leaved weeds *Boerhaavia diffusa*, *Parthenium hysterophorus* and *Digeria arvensis* were the dominant weeds. *Cyperus rotundus* was the only sedge present in the experimental field.

### Weed management methods on productivity of groundnut

In groundnut during both the years of study, among the weed control treatments, pre-emergence application of oxyfluorfen (23.5% EC) at 250 g ha<sup>-1</sup> recorded higher pod yield of 2058 and 2042 kg ha<sup>-1</sup> due to better control of weeds at critical stages thus providing favourable environment for better growth and development leading to enhanced pod yield. This treatment was comparable with the application of oxyfluorfen at 200 g ha<sup>-1</sup> with a pod yield of 1892 and 1868 kg ha<sup>-1</sup> during *kharif* 2009 and 2010, respectively (Table 1). Pre-emergence application of oxyfluorfen recorded lower weed density, weed dry weight and higher weed control efficiency, which in turn resulted in taller plants, maximum dry matter production, exhibited more pegs plant<sup>-1</sup> and finally higher pod yield of groundnut [5]. Hand weeding twice on 25 and 45 DAS and pre-emergence application of pendimethalin at 0.75 kg ha<sup>-1</sup> + HW on 45 DAS were the next best treatment compared to new formulation of oxyfluorfen (23.5% EC) at 200 and 250 g ha<sup>-1</sup> and recorded higher kernel weight, pod yield during both the years. This might be due to weed free environment condition and effective utilization of inputs and natural resources by the crop. Improved pod yield by integration of hand weeding with pre-emergence herbicide [6]. Integrated weed management practice that included pre-emergence application of pendimethalin at 0.75 kg ha<sup>-1</sup> + RW on 45 DAS registered lower pod yield compared to other weed control treatments and this might be due to partial or improper removal of *Cynodon dactylon* with rotary weeder, which recorded higher weed density, weed dry weight and higher nutrient removal by weeds. Moreover, this practice is not applicable during rainy season due to wet condition of the soil which does not permit mechanical weeding. Under such surroundings the chemical weed control measures are the alternate to control the weeds [7].

**Table 2.** Effect of weed management methods on soil micro-organism in groundnut.

Treatments	Kharif 2009						Kharif 2010					
	Bacteria (x10 <sup>6</sup> CFU g <sup>-1</sup> )		Fungi (x10 <sup>4</sup> CFU g <sup>-1</sup> )		Actinomycetes (x10 <sup>2</sup> CFU g <sup>-1</sup> )		Bacteria (x10 <sup>6</sup> CFU g <sup>-1</sup> )		Fungi (x10 <sup>4</sup> CFU g <sup>-1</sup> )		Actinomycetes (x10 <sup>2</sup> CFU g <sup>-1</sup> )	
	7	15	7	15	7	15	7	15	7	15	7	15
	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS	DAHS
T <sub>1</sub> -PE oxyfluorfen (Goal) at 200 g a.i ha <sup>-1</sup>	38.21	47.56	31.87	37.87	11.35	13.21	39.97	47.88	33.41	36.44	11.91	14.64
T <sub>2</sub> -PE oxyfluorfen at 150 g a.i. ha <sup>-1</sup>	38.56	47.31	34.56	40.12	13.94	15.63	40.32	47.63	36.10	38.69	13.29	17.06
T <sub>3</sub> -PE oxyfluorfen at 200 g a.i. ha <sup>-1</sup>	37.32	49.17	32.56	39.32	13.78	15.89	39.08	49.49	34.10	37.89	13.13	17.32
T <sub>4</sub> -PE oxyfluorfen at 250 g a.i. ha <sup>-1</sup>	37.17	46.85	30.42	39.78	13.28	14.82	38.93	47.17	31.96	38.35	12.63	16.25
T <sub>5</sub> -PE oxyfluorfen at 300 g a.i. ha <sup>-1</sup>	32.31	44.32	29.56	38.54	12.50	14.28	34.07	44.64	31.10	36.52	10.70	15.30
T <sub>6</sub> -PE oxyfluorfen at 400 g a.i. ha <sup>-1</sup>	30.78	43.17	26.87	36.54	10.48	13.87	32.54	43.49	28.41	35.11	9.83	15.38
T <sub>7</sub> -Pendi. at 0.75 kg ha <sup>-1</sup> + HW on 45 DAS	38.32	46.82	33.45	38.75	12.52	13.95	40.08	47.14	34.99	37.32	11.87	15.71
T <sub>8</sub> -Pendi. at 0.75 kg ha <sup>-1</sup> + RW on 45 DAS	37.38	47.15	32.87	37.95	13.04	15.74	39.54	47.47	34.41	37.11	12.39	17.17
T <sub>9</sub> -HW twice on 25 and 45 DAS	41.38	47.25	30.27	39.23	12.87	15.32	43.14	47.57	31.81	37.80	12.22	16.75
T <sub>10</sub> -Unweeded control	41.56	48.45	31.56	39.54	13.56	15.87	43.32	48.77	33.10	38.11	12.91	17.30
SEd	0.96	0.83	0.83	0.92	0.60	0.70	0.95	0.65	0.90	0.96	0.74	0.68
CD (p=0.05)	1.94	NS	1.65	1.87	1.32	NS	1.98	NS	0.85	1.93	1.54	NS

### Weed index

Weed index is indirectly related to the reduction in yield due to weed density and weed dry weight. The extent of yield reduction due to weed competition as assessed through weed index has evidently indicated the suppressing effect of pre-emergence application of oxyfluorfen at 250 g ha<sup>-1</sup> which registered minimum weed competition and maximum pod yield. Nearly, 59.3 and 55.4% yield reduction during first and second year, respectively was noticed under unweeded check against oxyfluorfen at 250 g ha<sup>-1</sup>, which might be the reason due to the increased magnitude of weed competition under unchecked weed growth (Table 1).

### Residual effect of herbicides on the soil micro organisms

Herbicides have the potential to influence the population and function of a diverse range of soil micro-organisms and thus alter soil fertility. There was significant reduction in counts of bacteria, fungi and

actinomycetes due to the pre-emergence application of oxyfluorfen at various doses viz., 150, 200, 250, 300 and 400 g ha<sup>-1</sup> and oxyfluorfen (goal) in early stages which recovered afterwards due to degradation of herbicides in soil (Table 2). Application of pendimethalin (0.75 and 1.0 kg ha<sup>-1</sup>) and fluchloralin (1.0 and 1.5 kg ha<sup>-1</sup>) reduced the total soil bacterial population and this was due to the fact that these microbes utilized the chemical as their food source [8]. The reason for the inhibitor effect of pendimethalin was due to the fact that it was applied directly to the soil and hence the amount of herbicide residues that comes in contact with soil was more in pendimethalin. Initial suppression of microbial count on 5<sup>th</sup> day of pendimethalin imposed plots, thereafter microbial population were observed growing normally after 25 days of application [9]. Pre-emergence application of oxyfluorfen, pendimethalin, fluchloralin and trifluralin had no deleterious effect on soil microorganisms at later stages of groundnut [10]. Results indicated that initial reduction in counts was due to inhibitory effect of these herbicides. But at later stage of 45

days after application of herbicide lost their potency, probably due to their degradation in soil. As the time passed on the microbes adjusted themselves to the new substrata and started growing normally.

### Conclusion

From the present investigation, it could be concluded that the application of oxyfluorfen (23.5% EC) at 250 g ha<sup>-1</sup> as pre-emergence herbicide can keep the weed density and dry weight below the economic threshold level and increase the pod yield in groundnut. Application of new formulation of oxyfluorfen (23.5% EC) did not left any adverse effect on the soil microflora after few days/months of their application during both the year.

### References

1. Page WW, Busolo-Bulapu CM, Vander PJA, Chancellor TCS (2002) Recommended groundnut production practices for smallholder farmers in Uganda. Univ Greenwich, Greenwich, London, SE10 9LS.
2. Gomez KA, Gomez AA (2010) Statistical procedures for agricultural research. Wiley India Pvt Ltd, New Delhi, India.
3. Snedecor GW, Cochran WG (1967) Statistical methods. Oxford and IBH Publ Co, New Delhi, pp 593.
4. Rao VS (2000) Weed research methodology, field experimentation. In : Principles of weed science. Oxford and IBH publ Co Pvt Ltd, pp 497—498.
5. Walia US, Surjit Singh, Buta Singh (2007) Integrated approach for the control of Hardy weeds in groundnut (*Arachis hypogaea* L.). Ind J Weed Sci 39 : 112—115.
6. Kumar GP (2004) Evaluation of early post-emergence herbicide for control of weeds in cotton and effect of its residue on crops grown in sequence. PhD thesis. Tamil Nadu Agric Univ, Coimbatore, Tamil Nadu, India.
7. Agasmani CA, Shanwad UK, Aravindkumar BN, Shivamurthy SD, Ashok Surwenshi BR, Jalageri BR (2010) Integrated weed management (IWM): A long term case study in groundnut-wheat cropping system in Northern Karnataka. Res J Agric Sci 1 : 196—200.
8. Sarkar A, Mukerjee PK, Battacharya PM (2005) Bio-efficacy of pendimethalin and fluchloralin in mustard. Ind J Weed Sci 37 : 270—273.
9. Das AC, Debnath A, Mukherjee D (2003) Effect of the herbicides oxadiazon and oxyfluorfen on phosphates solubilizing microorganisms and their persistence in rice field. Chemosphere 53 : 217—221.
10. Singh H, Singh S (2009) Weed management and soil micro organisms studies in irrigated summer groundnut (*Arachis hypogaea* L.). Ind J Weed Sci 41 : 103—107.