



## Pre-emergence herbicides for weed management in sesame

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The productivity of sesame (*Sesamum indicum* L) in India is the lowest in the world due to its cultivation in marginal and sub-marginal soils under rainfed situation with poor agronomic management practices (Bhaduaria 2012). Among the several constraints in sesame production, weed infestation is one of the major factors limiting the yield of sesame. Sowing of sesame seeds is very difficult as the seeds are very small and need to be placed precisely at optimum soil depth for good germination and establishment. The most common method of establishment of sesame is broadcasting, where the seeds are placed at shallow depth. The selectivity of pre-emergence herbicides under this condition is quite different from the line sowing. It is common that some of the crop seeds in broadcasting are placed on the surface of the soil and get damaged due to phytotoxicity of soil applied pre-emergence herbicide. The magnitude of phytotoxicity of commonly used pre-emergence herbicides to sesame seeds vary with type of soil, depth of sowing, dose of pre-emergence herbicides applied and moisture content of the soil or quantity of rainfall received after its application. These parameters significantly influence the selectivity mechanism and leaching behaviour of the pre-emergence herbicides. Due to shallow depth of sowing while broadcasting, the pre-emergence applied herbicides may come in close contact with the sesame seed, results in increased phytotoxicity or stand loss (Grichar *et al.* 2001).

Pre-emergence application of pendimethalin 1.0, 1.5, 2.0 and 2.5 kg/ha showed phytotoxicity rating of 4.8, 4.9, 6.0 and 6.2, respectively in sesame at 2 weeks after sowing (WAS) on sandy loam soils in 1-10 scale where 1= no crop injury and 10= complete crop kill (Imoloame *et al.* 2011). On the contrary, pre-emergence application of alachlor, fluchloralin and trifluralin at 1.5, 1.0 and 1.0 kg/ha, respectively in line sown sesame on loamy sands did not show any phytotoxicity to the crop (Sheroran *et al.* 2012).

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Phytotoxicity of pre-emergence herbicides on sesame was also reported by some researchers. The erratic behaviour of many soil applied herbicides was attributed due to method of establishment and rainfall or moisture content, which markedly influences the herbicide toxicity to sesame (Martin 1995). There is a paucity of data on seedling vigour index of the broadcast sesame to pre-emergence herbicides. The present study was conducted to know the response of broadcast sesame to some pre-emergence herbicides and to know their suitability.

A pot culture experiment was conducted at S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh during January, 2015 in order to estimate the effect of pre-emergence herbicides on germination per cent and seedling vigour index of the broadcast sesame in a completely randomized design with four treatments and five replications. The treatments consisted of pre-emergence application of pendimethalin 750 g/ha, oxyfluorfen 75 g/ha, oxadiargyl 75 g/ha and control. Circular plastic tubs (pots) of 46 cm diameter with a depth of 15 cm were selected and were filled with approximately 25 kg of soil. The soil used for the present experiment was sandy loam in texture with low in organic carbon (0.45%), available nitrogen (194 kg/ha) and available phosphorus (24 kg/ha) and medium in available potassium (175 kg/ha) with a soil P<sup>H</sup> of 6.4. Profuse watering was given to all the tubs after filling the soil to bring the soil under saturation and settling of the soil particles in it. The excess water was removed through drainage holes made at bottom of the tubs. The topsoil in the tub was tilled with hand operated racker to get fine tilth at field capacity to facilitate broadcasting of sesame seeds. Fifty seeds of sesame were broadcast in each plastic tub followed by racking with hand operated racker to simulate the conditions as that of field. All the pre-emergence herbicides were applied immediately after sowing at recommended doses. Pre-emergence herbicides, *viz.* pendimethalin, oxyfluorfen and oxadiargyl were

applied at 5, 0.6 and 0.18 ml/litre of water, respectively with the help of one litre mini hand operated sprayer as per the treatment. The data on number of seeds germinated, root and shoot length of sesame was recorded at 10 days after sowing. Phytotoxicity rating on the crop was observed at 10 days after pre-emergence application of herbicides in 0-10 scale where '0' indicate no crop damage and '10' indicate complete crop damage. The germination percentage and seedling vigour index (Abdul-Baki and Anderson 1973) of sesame were calculated based on the following formulae.

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds kept for germination}} \times 100$$

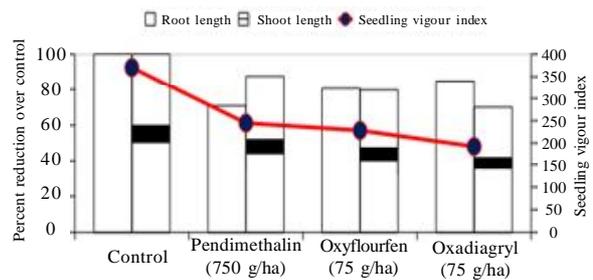
$$\text{Seedling vigour index} = \text{Germination percentage} \times \text{Seedling length (cm)}$$

### Germination percentage

The lowest germination percentage of broadcast sesame was recorded with pre-emergence application of oxadiargyl 75 g/ha, which was significantly lesser than the rest of the pre-emergence of herbicides tested (Table 1). Nethra and Jagannath (2011) also reported that the seed germination, length of the radical and plumule were severely affected with increased concentration of oxadiargyl in sunflower and maize crops under hydroponics. Pre-emergence application of pendimethalin 750 g/ha resulted in the highest germination (62.8%), which was comparable with pre-emergence application of oxyfluorfen 75 g/ha (60.2%). The decrease in germination of sesame with oxadiargyl, pendimethalin and oxyfluorfen treated plots were by 31.5, 22.2 and 18.8%, respectively compared to control.

### Seedling length

Among the pre-emergence herbicides tested, oxadiargyl 75 g/ha resulted in the highest root length of sesame at 10 DAS, which was at par with oxyfluorfen and both of them were significantly higher than the pre-emergence application of pendimethalin (Table 1). Oxadiargyl may inhibit the protophorphyrinogen oxidase, a key enzyme responsible for the biosynthesis of precursor substances for chlorophyll in plants rather than inhibiting the root growth and thus produced longer roots. The lowest root length of sesame was recorded with pendimethalin as it act as root inhibitor rather than shoot by disturbing cell division. The reduction in root length was 29.0, 19.4 and 15.0% with pre emergence application of pendimethalin, oxyfluorfen and oxadiargyl applied 750, 75 and 75 g/ha, respectively (Fig.1).



**Fig. 1. Effect of pre-emergence herbicides on root / shoot growth and seedling vigour index in broadcast sesame**

Among the herbicides tested, the highest shoot length of sesame was produced with pre-emergence application of pendimethalin, which was significantly higher compared to oxyfluorfen. Pre-emergence application of oxadiargyl, oxyfluorfen and pendimethalin reduced the shoot length by 29.8, 20.2 and 12.3% compared to control (Fig.1). Pre-emergence application of oxadiargyl might inhibited the chlorophyll synthesis in treated plots resulted in bleaching of the leaves and finally reduced the shoot growth. Similar results were also reported by (Nethra and Jagannath, 2011).

### Seedling vigour index

Seedling vigour index of sesame was significantly influenced by pre-emergence application of herbicides as it is the product of the germination percent and seedling length. All the herbicides tested in the present study significantly reduced the germination percent and length of the seedling. Among the herbicides tested, the highest seedling vigour index of broadcast sesame was observed with pre-emergence application of pendimethalin 750 g/ha (247.7), which was comparable with oxyfluorfen 75g/ha (228.2). On contrary, Imoloame *et al.* (2011) reported that pre-emergence application of pendimethalin at higher dose significantly reduced the crop vigour index of sesame. The lowest seedling vigour index of sesame with pre-emergence application of oxadiargyl 75 g/ha was due to reduced germination percentage and decreased seedling length of sesame as oxadiargyl showed phytotoxicity on sesame seedlings (Table 1).

### Phytotoxicity

Among the pre-emergence herbicides, oxadiargyl 75 g/ha showed the phytotoxicity rating of 6.0 in 0-10 scale where '0' indicate no injury and '10' indicate complete crop damage. Pre-emergence application of oxyfluorfen 75 g/ha showed phytotoxicity rating of '4' followed by pendimethalin

**Table 1. Effect of pre-emergence herbicides on seedling length, vigour index and phytotoxicity on broadcasted sesame**

Treatment	Germination (%)	Seedling length (cm)		Seedling vigour index	Phytotoxicity rating
		Root length	Shoot length		
Pendimethalin 750 g/ha	62.8	1.32	2.56	244.7	3.00
Oxyfluorfen 75 g/ha	60.2	1.50	2.33	228.2	4.00
Oxadiargyl 75 g/ha	53.0	1.58	2.05	192.4	6.00
Control	77.4	1.86	2.92	370.0	0.00
LSD (P = 0.05)	4.32	0.10	0.16	18.2	-

750 g/ha with phytotoxicity rating of '3'. The phytotoxicity effect of oxyfluorfen and pendimethalin on sesame seedlings were recovered within 15 days after herbicide application.

### SUMMARY

The study was conducted at S.V. Agricultural College, Tirupati during summer 2015 in a complete randomized design with four treatments consisting of pre-emergence application of pendimethalin 750, oxyfluorfen and oxadiargyl 75 g/ha each and control replicated five times. Among the herbicides tested, pre-emergence application of pendimethalin 750 g/ha recorded the highest seedling vigour index followed by oxyfluorfen 75 g/ha in broadcast sesame on sandy loam soils. Pre-emergence application of oxadiargyl 75 g/ha showed phytotoxicity rating of "6" in broadcast sesame.

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