Indian Journal of Weed Science **51**(4): 390–392, 2019

Print ISSN 0253-8040 Online ISSN 0974-8164

Allelopathic effect of sorghum and sunflower on *Phalaris minor* and wheat

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Article information

DOI: 10.5958/0974-8164.2019.00081.9

Type of article: Research note

Received : 14 July 2019
Revised : 30 September 2019
Accepted : 4 October 2019

Key words
Allelopathy, Aqueous extract, *Phalaris minor*, Sorghum, Sunflower

ABSTRACT

A field experiment was conducted in G.B Pant University of Agriculture and Technology, Pantnagar during *Rabi* season of 2018-19 to evaluate the bioefficacy of aqueous extracts of sorghum and sunflower on *Phalaris minor*, as well as their effects on yield and yield attributing characters of wheat. The experiment was carried out with eight treatments, each with three replications in randomized block design (RBD). Treatment with pre *fb* early post-emergence application of sunflower extract recorded highest weed control efficiency and yield among the treatments having aqueous extract application. Maximum WCE was recorded in pre *fb* early post-emergence application sunflower followed by pre *fb* early post-emergence application sorghum in every stages of observation. The grain yield of weedy, pre- *fb* early post-emergence application sorghum, pre- *fb* early post-emergence application sunflower, weed free plot was recorded as 2.33, 4.13, 4.38, 5.14t/ha, respectively.

Uncontrolled weeds caused 45.6% reduction in the grain yield of wheat as compared to weed free condition (Singh *et al.* 2001). Among all the weed species associated with wheat *Phalaris minor* is the most severe one and require a huge application of herbicides for its control (Om *et al.* 2002). *Phalaris minor* gradually developed resistance due to continuous application of herbicides to many of the conventional herbicides like isoproturon (Chhokar and Malik 2002).To tackle the emerging problem of herbicide resistance in *Phalaris minor* allelopathic approach can be a potential tool (Dimitrova 2008). In several experiments it is reported that both sorghum and sunflower have a very good allelopathic effect in controlling *Phalaris minor*, without hampering wheat crop (Cheema 1988, Naseem 1997).

An one year field experiment was conducted during *Rabi* season of 2018-19 at N.B Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). The soil of the experimental site was clay loam in texture with 0.92% organic matter, and pH of 6.9. Available N, P and K content in the soil was 248.3, 27.7 and 182.4 kg/ha, respectively. Wheat variety '*DBW 17*' with seed rate of 100 kg/ha was sown manually in 20 cm row-row spacing. The seeds of *Phalaris minor* were broadcasted over the experimental area evenly and duly incorporated. Crop was fertilized with 120:60:40 kg N, P_2O_5 and K_2O/ha. P_2O_5 and K_2O were supplied asbasal and N was applied with three splits (50% basal, 25% at first irrigation, and 25% at second irrigation). The experiment was laid out in a randomized block design with three replications. The details of the treatments and their scheduling are given in **Table 1**. The aqueous extracts were applied at pre-emergence (1 DAS) and early post-emergence (10 DAS) using 400l/ha of water with knapsack sprayer fitted with a flat fan nozzle.

For preparing aqueous extract of sorghum and sunflower, the fresh biomass of these crops were dried under shade for one week and then dried at 65±5^{0}C in electric drier for 72 hours. After full drying, the biomass was ground finely in electric grinder. 10% (w/v) aqueous extract was prepared by dissolving 400 g of dried biomass powder in 4l of distilled water.

At the time of sampling (20, 40, 60 days after sowing and maturity; DAS), a quadrate of 50 × 50 cm^2 was placed at a fixed place in each plot to determine the dry weight of *Phalaris minor*. Dry weight was recorded after drying the samples at 65±5^{0}C for 72 h. Weed control efficiency was calculated based on the data recorded at 20, 40, 60 DAS and maturity in wheat as per standard formula. Number of spikes/m^2, spike length (cm), grains/

spike, 1000 grain weight (g), grains/panicle, grain and straw yield (kg/ha) was recorded just before harvesting. The grain and straw yield was recorded from net plot area of 1.2 m^2 area, and wheat grain yield was expressed at 12% moisture content.

Data were analyzed using statistical package STPR, developed by College of Basic Science and Humanities, GBPUA&T, Pantnagar. The data of *Phalaris minor* dry matter was square root transformed before analysis. The CD was provided at 5% level of significance.

Dry matter of *Phalaris minor*

Significant variation was observed with dry matter accumulation of *Phalaris minor* at 20 DAS. Significantly lowest dry matter accumulation was recorded in aqueous extract of sunflower 10% pre-*fb* early post-emergence application which was statistically at par with aqueous extract of sorghum 10% pre *fb* early post-emergence spray Control plot has significantly highest (1.69 g/m^2) dry matter accumulation of *Phalaris minor* than other treatments.At 40 and 60 DAS, lowest dry matter accumulation was under aqueous extract of sunflower 10% pre-emergence spray, followed by aqueous extract of sorghum 10% pre-emergence spray. The weed control efficiency was found maximum with application of aqueous extract of sunflower10% pre *fb* early post-emergence spray in every stage of the crop growth. This reveals that treatments with aqueous extracts of sunflower have better allelopathic effect on *Phalaris minor* in comparison to other treatments. The allelopathic effect of sunflower is due to allelochemicals like chlorogenic, caffeic, syringic, vanillic and ferulic acid (Ghafar*et al*. 2001). Dry matter accumulation had direct relation with number of shoots at every stage.

It can be observed that the WCE rapidly decreased after 60 DAS due to deterioration of the allelochemicals effect. Hence at maturity, two best performing treatments *i.e*. aqueous extract of sunflower10% pre *fb* early post-emergence spray and aqueous extract of sorghum 10% pre *fb* early post-emergence spray recorded lower weed control efficiency of 23.43 and 20.08% only respectively. These results were in agreement with the reports of Cheema *et al*. (1997), Cheema and Khaliq (2000) and Naseem (1997). Hence, an inference can be drawn that aqueous extracts of sunflower are more efficient in managing *Phalaris minor* population than that of sorghum for a longer period of time.

Wheat yield and yield attributing characters

Various aqueous extract of sorghum and sunflower treatments significantly affected the number of spikes per square meter. Weed free plot recorded significantly highest number of spikes per square meter and grain yield and was statistically at

Table 1. Effect of aqueous extracts of sorghum and sunflower (10%) on dry matter accumulation (g/m^2) of *P. minor*

Treatment	Dry matter accumulation (g/m^2) of *Phalaris minor*			
	20 DAS	40 DAS	60 DAS	At maturity
Control (no application)	1.69(1.92)	8.19(51.49)	12.25 (148.97)	20.90(436.51)
Sorghum (10%) PE	1.46(1.15)	6.19(37.63)	11.05(121.06)	18.98(359.56)
Sorghum (10%) EPoE	1.62(1.61)	7.08(48.12)	11.88(140.21)	20.35(413.09)
Sorghum (10%) PE *fb*EPoE	1.34(0.87)	5.33(29.47)	9.93(97.66)	18.70(348.84)
Sunflower (10%) PE	1.52(1.32)	6.37(40.70)	10.94(118.79)	19.21(368.37)
Sunflower (10%) EPoE	1.59(1.52)	6.76(44.97)	11.55(132.49)	20.22(408.16)
Sunflower (10%) PE *fb*EPoE	1.30(0.68)	4.03(22.23)	9.13(82.44)	18.30(334.29)
Weed free	1.00(0.00)	1.00(0.00)	1.00(0.00)	1.00(0.00)
LSD (p=0.05)	0.20	0.18	0.24	0.92

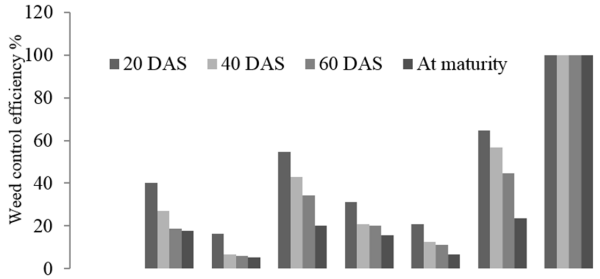
*Original values are given in parentheses; PE= pre-emergence; EPoE= early post-emergence

Table 2. Effect of aqueous extracts of sorghum and sunflower (10%) on yield attributes of wheat

Treatment	No of spikes /m^2	Spike length (cm)	No of grains/spike	Thousand grain weight (g)
Control (no. application)	322	9.98	18	41.16
Sorghum (10%) pre-emergence	436	10.34	27	41.39
Sorghum (10%) early post-emergence	411	10.15	25	41.54
Sorghum (10%) pre-emergence *fb* early post-emergence	452	10.10	29	42.68
Sunflower (10%) pre-emergence	449	10.31	29	41.37
Sunflower (10%) early post-emergence	422	10.28	27	42.56
Sunflower (10%) pre-emergence *fb* early post-emergence	476	10.21	31	42.31
Weed free	511	10.46	32	42.87
LSD(p=0.05)	100	NS	NS	NS

Table 3.Effect of aqueous extracts of sorghum and sunflower (10%) on yield of wheat

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Grain: straw ratio	Harvest index
Control (no. application)	2.33	3.37	5.68	0.70	0.41
Sorghum (10%) pre-emergence	3.88	4.78	8.66	0.83	0.45
Sorghum (10%) early post-emergence	2.92	3.58	6.50	0.87	0.46
Sorghum (10%) pre-emergence *fb* early post-emergence	4.13	5.30	9.43	0.80	0.44
Sunflower (10%) pre-emergence	3.57	4.73	8.30	0.76	0.43
Sunflower (10%) early post-emergence	3.32	3.61	6.93	0.92	0.48
Sunflower (10%) pre-emergence *fb* early post-emergence	4.38	5.56	9.73	0.82	0.45
Weed free	5.14	5.63	10.70	0.93	0.48
LSD(p=0.05)	0.77	1.54	1.98	NS	NS



T_1= Control (no. application); T_1= Sorghum (10%) pre-emergence; T_3= Sorghum (10%) early post-emergence; T_4= Sorghum (10%) pre-emergence *fb* early post-emergence; T_5= Sunflower (10%) pre-emergence; T_6= Sunflower (10%) early post-emergence; T_7= Sunflower (10%) pre-emergence *fb* early post-emergence; T_8= Weed free

Figure 2. Effect of aqueous extracts of sorghum and sunflower (10%) on weed control efficiency at various growth stages

par with aqueous extract of sunflower 10% pre-emergence *fb* early post-emergence spray.

The most probable reasons behind higher grain yield were higher dry matter production by wheat, higher weed control efficiency which ranged up to 23.04%, 12.08% and 17.63% under aqueous extractsunflower 10% pre-emergence *fb* early post-emergence spray, aqueous extract of sorghum 10% pre-emergence *fb* early post-emergence spray and aqueous extract of sorghum 10% pre-emergence spray and higher number of spikes per square meter.

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