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Performance of new herbicides in groundnut and their carryover effect on fodder sorghum

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ABSTRACT

Field experiments were conducted during winter, 2018-19 and summer, 2019 in groundnut and fodder sorghum, respectively at S.V. Agricultural College, Tirupati, Andhra Pradesh, India to know the performance of pre-emergence (pendimethalin 38.7% CS 725 g/ha and diclosulam 84% WDG 20 g/ha) and post-emergence (haloxyfop-p-ethyl 10.5% EC 135 g/ha and cycloxydim 20% EC 100 g/ha) herbicides on weed growth and yield of groundnut and their carryover effect on fodder sorghum. Significantly lower density and dry weight of weeds with higher WCE were recorded with pre-emergence application of diclosulam 20 g/ha + HW at 40 DAS and it was closely followed by pre-emergence application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha applied at 20 DAS in groundnut. The highest pod yield and benefit-cost ratio were registered with former weed management practice. All the herbicides tried did not show any inhibitory effect on germination, growth parameters and dry fodder yield of residual crop of fodder sorghum. Pre-emergence application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha applied at 20 DAS in groundnut showed its superiority in supressing weed growth at early stages of fodder sorghum due to extended herbicidal activity of diclosulam and reduced weed seed bank.

Groundnut (*Arachis hypogaea* L.) is important oil, food and forage crop of the country. India is the second largest producer of groundnut in the world. Among different constraints that limit the productivity of groundnut, weed menace is one of the serious bottlenecks (Chaitanya *et al.*2012). Season long weed competition in groundnut reduced the pod yield to the tune of 40% on sandy loam soils (Clewis *et al.* 2007). Pre-emergence application of herbicides is more common method for weed control in groundnut as it gives the crop a good start, by eliminating early weed competition. Pendimethalin is the commonly used dinitroaniline herbicide for control of annual grasses and some of the broad-leaved weeds, but less effective against perennial sedge, *Cyperus rotundu*s as it is less mobile and lower half-life period. Ideally, the herbicides should have reasonably acceptable residual activity during crop growing season for effective and season long weed control without affecting the succeeding crops. Some herbicides such as imazethapyr or atrazine persist in the soil for long time and showed their residual effect on succeeding susceptible crop. Post-emergence application of imazethapyr 75 g/ha is recommended for control of weeds in groundnut, but the choice of succeeding crops is limited because of its persistence in soil and plant for longer time with a half-life period of 33 months (Sondhia *et al.* 2015). However, persistence of imazethapyr depends upon soil type and its half-life which is 24 and 5 months in clay and sandy soils, respectively (Hollaway *et al.* 2006). There is need to evaluate alternate pre-and post-emergence herbicides for broad-spectrum weed control in groundnut and their residual effect on succeeding rotational crops. In recent years, new generation low- dose and high potent herbicides are available for control of mixed weed flora with reasonably good residual activity and low mammalian toxicity. Fodder sorghum cultivation is emphasized owing of its drought-tolerant characteristics and high production potential to meet the fodder requirement during dry periods after harvesting of groundnut in Southern Agroclimatic Zone of Andhra Pradesh. Therefore, the present investigation was undertaken with an objective to assess the performance of low dose high efficacy pre-and post-emergence herbicides and their carryover effect on succeeding fodder sorghum.

Field experiments were conducted during *Rabi* (winter) 2018-19 in groundnut and summer 2019 in fodder sorghum on sandy loam soil of dryland farm of S.V. Agricultural College, Tirupati, Andhra Pradesh India with eleven weed management practices consisted of pre-emergence (PE) application of diclosulam 84% WDG 20 g/ha alone and followed by HW at 40 DAS and sequential post-emergence (PoE) application of haloxyfop-p-ethyl 10.5% EC 135 g/ha or cycloxydim 20% EC 100 g/ha at 20 DAS, PE application of pendimethalin38.7% CS 725 g/ha alone and supplemented with HW at 40 DAS or sequential post-emergence application of haloxyfop-p-ethyl 135 g/ha or cycloxydim 100 g/ha at 20 DAS along with PE application of pendimethalin 30% EC 1000 g/ha, two HW at 20 and 40 DAS and unweeded check, which were laid out in a randomized block design with three replications. The soil was low in organic matter content, available nitrogen and phosphorous and medium in available potassium. Pre-and post-emergence herbicides were applied to groundnut '*Kadiri-6'* at one and 20 DAS by using power operated knapsack sprayer fitted with flat-fan nozzle with spray fluid of 500 L/ha. The crop was supplied with recommended fertilizer dose of 20 kg N, 40 kg P and 50 kg K/ha through urea, single super phosphate and muriate of potash, respectively to all the plots as basal. Top dressing of 10 kg of N in the form of urea was applied at 25 DAS. Data on weeds were recorded at harvest in each plot with the help of quadrat measuring 50 x 50 cm. Weed samples were sun dried at 70^0C until constant weight was attained. The succeeding fodder sorghum '*Co FS-29'* was sown in undisturbed layout of experiment field, immediately after harvest of groundnut. Density and dry weight of weeds in groundnut were recorded at 60 DAS and the data on weeds and growth parameters of fodder sorghum were recorded at 15 and 30 DAS. Weed data in both crops was transformed to square root transformation ($\sqrt{X+0.5}$) to normalize their distribution. Weed control efficiency of each treatment was calculated (Mani *et al.* 1973). The data on both crops were analysed by the analysis of variance and means were separated with least significant difference at 5% level of probability.

Effect on groundnut

The predominant weed flora associated with groundnut was *Cyperus rotundus* L. (42%), *Boerhavia erecta* L. (15%), *Dactyloctenium aegyptium* (L.) Willd. (11%), *Commelina benghalensis* L. (10%), *Digitaria sanguinalis* (L.) Scop. (8%), *Cleome viscosa* L.(6%), *Phyllanthus niruri* L. (4%) and others (4%). Significantly lower density and dry weight of total weeds was recorded with PE application of diclosulam 20 g/ha +HW at 40 DAS followed by PE application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha applied at 20 DAS in groundnut **(Table 1)**. Similar trend of influence was noticed with respect to grasses, sedges and broad-leaved weeds due to above said treatments. Diclosulam inhibits the ace to lactate synthase (ALS) enzyme activity in target plants, a key enzyme responsible for biosynthesis of branched chain amino acids in target weeds. Diclosulam might have increased its concentration at deeper layers of the soil as a soluble herbicide due to higher half-life period coupled with higher leaching potential index and lower sorption coefficient (Hornsby *et al.*1986) lead to increased control of purplenut sedge and broad-leaved weeds. Grichar *et al* (1999) also stated that diclosulam 10 g/ha in combination with ethalfluralin 840 g/ha found to be effective against broad-leaved weeds and perennial sedges in groundnut on sandy soils. Significantly higher pod and haulm yield was registered with PE application of diclosulam 20 g/ha supplemented with HW at 40 DAS, however which was at par with sequential application of diclosulam 20 g/ha as PE *fb* cycloxydim 100 g/ha. Aruna and Sagar (2018) also concluded that PE application of pendimethalin 1.5 kg/ha followed by post-emergence application of imazethapyr 75 g/ha at 18-20 DAS was effective in controlling both broad-leaved weeds and grasses in groundnut. Both the formulations of pendimethalin were found to be inferior in controlling density and dry weight of sedges and broad-leaved weeds, but effective in controlling grassy weeds compared to diclosulam 20g/ha (data not presented). The highest benefit-cost ratio was computed with PE application of diclosulam 20 g/ha supplemented with HW at 40 DAS followed by PE application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha due to reduced cost of weeding and increased pod as well as haulm yield. Punia *et al.* (2016) also stated that higher net returns and benefit-cost ratio were obtained with sequential application of pendimethalin as PE and imazethapyr 75 g/ha as post-emergence in groundnut.

Carryover effect of herbicides on fodder sorghum

The major weeds associated with fodder sorghum consisted of *Cyperus rotundus* L. (38%), *Cleome viscosa* L. (27%), *Boerhavia erecta* L. (13%), *Dactyloctenium aegyptium* (L.) Willd. (8%), *Commelina benghalensis* L. (4%), *Digitaria sanguinalis* (L.) Scop. (4%), *Phyllanthus niruri* L. (3%) and other weeds (3%). There is a shift in weed flora from groundnut to succeeding fodder sorghum due to carryover effect of herbicidal treatments applied to groundnut. The relative densities of weeds in groundnut and fodder sorghum clearly shows that sedges and grasses were reduced and broad-leaved weeds like *Cleome viscosa* was increased in fodder sorghum compared to groundnut. All the weed management practices imposed to preceding groundnut significantly influenced the growth character like germination per cent, root and shoot length, dry matter production and green fodder yield of succeeding fodder sorghum (**Table 2**). The lowest density of total weeds in fodder sorghum was recorded with PE application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha applied to groundnut and it was at par with PE application of diclosulam 20 g/ha supplemented with HW at 40 DAS. The later weed management practice recorded significantly lower weed dry weight than former treatment in fodder sorghum. Both the weed management practices were significantly superior in reducing density and dry weight of total weeds in fodder sorghum due to effective control of all the categories of weeds in groundnut, which in turn produced lesser weed seed bank deposition in succeeding fodder sorghum. Further, diclosulam might have extended its herbicidal activity due to its favourable physico-chemical properties like higher half-life period (87 days) and leaching potential index (129) with lower sorption coefficient (0.22 L/kg) resulted in more quantity of diclosulam as a free herbicide available at deep layers of soil (Hornsby *et al.*1986). Pre-emergence application of both the formulations (CS and EC) of pendimethalin applied to groundnut registered higher density and dry weight of weeds in succeeding fodder sorghum might be due to lower half-life period (40 days) and leaching potential index (5) with higher sorption coefficient (25.55 L/kg).

All the herbicides applied to groundnut did not show any inhibitory effect on growth and yield of succeeding fodder sorghum. Germination percentage of fodder sorghum did not influenced due to different herbicides applied to groundnut. Diclosulam applied plots recorded significantly higher stature of growth parameters and dry fodder yield than rest of the treatments **(Table 2)**. Pre-emergence application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha applied to groundnut produced significantly higher root length, shoot length and dry matter production of succeeding fodder sorghum. This might be due to maintenance of weed free environment as a result of carryover effect of diclosulam up to early stages of fodder sorghum because of its longer half-life period. The highest green fodder yield of succeeding fodder sorghum was obtained with pre-emergence application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha at 20 DAS, which was closely followed by sequential application of diclosulam 20 g/ha supplemented with HW at 40 DAS imposed in preceding groundnut. This might be due to extended herbicidal activity diclosulam even after harvest of groundnut.

On basis of the above study, it can be concluded that pre-emergence application of diclosulam 20 g/ha supplemented with HW at 40 DAS provided excellent control weeds, which resulted in higher pod yield and benefit:cost ratio, which was at par with sequential application of diclosulam 20 g/ha and cycloxydim 100 g/ha applied at 20 DAS in groundnut. Diclosulam 20 g/ha, pendimethalin 1000 g/ha, cycloxydim 100 g/ha and haloxyfop 135 g/ha applied to groundnut did not show any inhibitory effect on succeeding fodder sorghum. However, pre-emergence application of diclosulam 20 g/ha *fb* cycloxydim 100 g/ha applied at

Table 1. Effect of different weed management practices on weed growth, WCE, yield and economics of groundnut during winter 2018-19

Treatment	Dose (g/ha)	Time of application (DAS)	Weed density (no./m^2)	Weed dry weight (g/m^2)	WCE (%)	Pod yield (t/ha)	Haulm yield (t/ha)	Shelling (%)	B:C ratio
Pendimethalin (CS)	725	1	6.37(39.7)	5.02(24.3)	63.69	1.56	2.57	68.43	2.04
Diclosulam	20	1	3.63(12.3)	2.58(5.7)	91.45	1.71	2.74	71.16	2.29
Pendimethalin *fb* hand weeding	725	1 *fb* 40	5.19(26.0)	3.81(13.6)	79.67	1.60	2.61	69.05	1.97
Diclosulam *fb* hand weeding	20	1 *fb* 40	2.07(3.3)	1.61(1.6)	97.57	2.10	3.05	73.87	2.62
Pendimethalin *fb* haloxyfop-p-ethyl	725 *fb*135	1 *fb* 20	6.60(42.7)	5.10(25.1)	62.49	1.65	2.68	70.10	2.02
Diclosulam *fb* haloxyfop-P-ethyl	20 *fb*135	1 *fb* 20	3.35(10.3)	2.50(5.3)	92.09	1.86	2.85	71.89	2.32
Pendimethalin *fb* cycloxydim	725 *fb*100	1 *fb* 20	6.26(38.3)	4.91(23.7)	64.58	1.70	2.73	70.61	2.14
Diclosulam *fb* cycloxydim	20 *fb*100	1 *fb* 20	3.03(8.3)	2.13(3.6)	94.67	1.93	2.91	72.43	2.47
Pendimethalin (EC)	1000	1	8.05(64.3)	5.15(26.0)	61.06	1.62	2.62	69.47	2.12
Hand weedings	-	20 *fb* 40	4.19(16.7)	2.88(7.3)	89.05	1.81	2.81	73.21	2.10
Unweeded check (control)	-	-	13.22(174.3)	8.21(66.9)	-	1.08	1.95	62.85	1.50
LSD (p=0.05)	-	-	0.56	0.39	-	0.24	0.32	2.46	0.14

CS: Capsulated suspension, EC: Emulsifiable concentrate, *fb*: followed by, WCE: Weed control efficiency, Data on weed density and dry weight are subjected to square root transformation: Data given in parentheses are original values

Table 2. Carryover effect of different herbicides applied to groundnut on weed parameters, growth and green fodder yield of succeeding fodder sorghum during summer, 2019

Treatment	Dose (g/ha)	Time of application (DAS)	Weed density (no./m^2)	Weed dry weight (g/m^2)	Germination (%)	30 DAS Shoot length (cm)	30 DAS Root length (cm)	30 DAS DMP (kg/ha)	Dry fodder yield (t/ha)
Pendimethalin (CS)	725	1	9.34(94.7)	6.09(36.2)	90.91	106	9.9	5812	1.8
Diclosulam	20	1	6.01(42.3)	4.20(16.6)	90.50	125	13.0	6788	2.3
Pendimethalin *fb* hand weeding	725	1 *fb* 40	8.73(81.9)	5.88(33.6)	92.97	106	10.9	5892	2.0
Diclosulam *fb* hand weeding	20	1 *fb* 40	6.11(42.3)	4.30(17.5)	94.45	128	13.2	6816	2.7
Pendimethalin *fb* haloxyfop-p-ethyl	725 *fb* 135	1 *fb* 20	9.03(87.0)	5.92(34.1)	92.42	109	10.4	6005	2.1
Diclosulam *fb* haloxyfop-p-ethyl	20 *fb* 135	1 *fb* 20	6.32(47.3)	4.47(19.1)	91.12	121	13.2	6746	2.5
Pendimethalin *fb* cycloxydim	725 *fb* 100	1 *fb* 20	8.63(81.0)	5.79(32.6)	93.94	115	11.5	6057	2.2
Diclosulam *fb* cycloxydim	20 *fb* 100	1 *fb* 20	5.77(39.7)	4.42(18.6)	92.91	140	13.3	6982	2.9
Pendimethalin (EC)	1000	1	8.81(84.7)	5.79(32.6)	91.45	118	12.3	6298	1.9
Hand weedings	-	20 *fb* 40	9.02(83.0)	5.85(33.3)	94.48	121	11.2	6458	2.2
Unweeded check (control)	-	-	11.11(141.7)	7.26(51.8)	90.05	99	9.8	5096	1.6
LSD (p=0.05)	-	-	0.57	0.38	NS	14.6	1.5	769	0.2

CS: Capsulated Suspension, EC: Emulsifiable Concentrate, *fb*: Followed by, DMP: Dry matter production, Data on weed density and dry weight are subjected to square root transformation: Data given in parentheses are original values

20 DAS in groundnut showed its superiority in supressing weed growth at early stages of fodder sorghum due to extended herbicidal activity of diclosulam.

REFERENCES

Aruna E and Karuna Sagar G. 2018. Weed management in groundnut under rice-fallow. *Indian Journal of Weed Science* **50**(3): 298–301.

Chaitanya S, Shankaranarayana V and Nanjappa HV. 2012. Chemical weed management in *Kharif* groundnut. *Mysore Journal of Agricultural Sciences* **46**: 315–319.

Clewis SB, Everman WJ, Jordan LD and Wilcut JN. 2007. Weed management in north carolina peanut (*Arachis hypogaea*) with S-metalochlor, diclosulam, flumioxazin and sulfentazone system. *Weed Technology* **21**: 629–635.

Grichar WJ, Dotray PA and Sestak DC. 1999. Diclosulam for weed control in texas peanut. *Weed Technology* **26**: 23–28.

Hollaway KL, Kookana RS, Noy DM, Smith JGN and Wilhelm C. 2006. Persistence and leaching of imazethapyr and flumetasulam herbicides over a 4-year period in the hilly alkaline soils of South-Eastern Austalia. *Australian Journal of Experimental Agriculture* **46**: 669–674.

Hornsby AG, Donwauchope R and Herner AE. 1996. Pesticide properties in the environment. *Springer-Verlag, Inc.*, New York.

Mani VS, Malla ML, Gautam KC, Bhagavandas.1973. Weed killing chemicals in potato cultivation. *Indian Farming* **23**: 17–18.

Punia TC, Karwasara PK, Mathukia RK and Sharma A. 2016. Productivity and economics of rainy season groundnut as influenced by weed management practices. *Indian Journal of Weed Science* **48** (4): 400–403.

Sondhia S, Khankhane PJ, Singh PK and Sharma AR. 2015. Determination of imazethapyr residues in soil and grains after its application to soybean, *Journal of Pesticide Sciences* **40**: 106–110.