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Efficacy of conventional and herbicidal approach on weed flora in *Rabi* groundnut (*Arachis hypogaea* L.)

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Abstract
A field experiment was conducted during *rabi* 2017-18 at Central Research Station, OUAT Bhubaneswar to assess the efficacy of conventional and herbicidal approach on weed flora in groundnut. The experiment was laid in a randomized block design with fourteen treatments replicated thrice. Uncontrolled weed growth throughout the crop season resulted in yield loss of about 54.4% in *rabi* groundnut. *Digitaria ciliaris, Digitaria sanguinalis Eleusine indica, Dactyloctenium aegyptium, Panicum maximum* among grasses, *Borreria hispida, Cleome rutidosperma, Croton sparsiflorus, Tephrosia purpurea, Phyllanthus niruri, Celosia argentea* among broadleaved weeds and *Cyperus rotundus,* the only sedge were the predominant weeds found in the experimental plot. Amongst the herbicidal treatments, pre-emergence application of oxyfluorfen @ 0.05kg/ha (PE) +1 Handweeding at 20 DAS significantly reduced the weed density (27.90 number/m^2), weed dry weight (50.50 g/m^2) and showed the highest weed control efficiency.(84.6%).

Keywords: oxyfluorfen, weed density, weed control efficiency, weed dry weight

Introduction
Groundnut (*Arachis hypogaea* L), the unpredictable legume' is the 13th most important food crop and 4th most important oilseed crop of the world and accounting for 17.4% of the area and about 26.7% of the total national production of all the oilseeds. It occupies an area of 4.56 mha with a production of 6.77 mt and productivity of 1486 kg/ha. (Directorate of Economics & Statistics, DAC & FW, 2015-2016). Heavy weed infestation is one of the important factors contributing to the low productivity of groundnut. Weed control is more critical in groundnut than in other crops because of its slow growth which makes it a poor competitor of weeds. Hence, weeds should be controlled during the first 4-8 weeks after planting. In groundnut, the loss in pod yield ranges from 13 to 100% depending on the season, cultivars, weed composition and duration of crop weed competition, and the packages of practices adopted (Ghosh, 2000) [2]. Besides competing for resources weeds hinder pegging, compete for underground space, and make harvesting of groundnut cumbersome. The presence of weeds for long time in the field affects the pod size, thus deteriorating the quality of the produce and fetching a lower price in market. Conventional methods like manual weeding is mostly practiced to control weeds in groundnut. But unavailability and scarcity of labourers, hike in the labour wages and unfavourable environmental conditions during the critical period of crop-weed competition reduces the effectiveness and reliability of hand weeding. Therefore, herbicides alone or in combination with manual weeding provide an economically viable alternative for weed control. Thus the present study was undertaken to assess the efficacy of conventional and herbicidal approach on growth and yield attributes in *rabi* groundnut.

Materials and Methods
The field study was conducted at Central Research Station, OUAT Bhubaneswar. The latitude and longitude of the research station is 21^0 15' N and 85^0 52' E, respectively, with an altitude of 25.9 m above the mean sea level and the station is situated at about 64km away from the Bay of Bengal. The station belongs to the East and South Eastern Coastal Plain Agro-climatic Zone of Odisha. The experiment was laid out in a Randomized Block Design (RBD) with 14 different weed management treatments replicated thrice comprising comprising T1- pre-emergence (PE) application of pendimethalin @1kg/ha, T2-oxyfluorfen @0.05kg/ha (PE), T3-

post emergence application (PoE) of imazethapyr @0.12 kg/ha at 20 DAS, T4- quizalofop- ethyl @0.05 kg/ha (PoE) at 20DAS, T5-pendimethalin @1kg/ha (PE) +1 HW at 20 DAS, T6-oxyfluorfen @ 0.05kg/ha (PE) + 1HW, T7- pendimethalin @1kg/ha (PE) fb quizalfop-ethyl @0.05kg/ha (PoE) at 20DAS,T8-pendimethalin @1kg/ha (PE) fb imazethapyr @0.12kg/ha (PoE) at 20DAS,T9-oxyfluorfen@0.05kg/ha (PE) followed by quizalfop-ethyl @0.05kg/ha(PoE) at 20 DAS,T10-oxyfluorfen @0.05kg/ha fb imazethapyr @0.12kg/ha (PoE) at 20 DAS, T11- farmers Practice at 20 DAS, T12- Two hand weedings at 20 fb 40 DAS, T13-weed free and T14-weedy check. ICGV91114" (Devi) was the test variety of the experiment. The soil was acidic (pH-4.90) and sandy loam in texture with low organic carbon (0.37%) and available N of 192.4 kg/ha, P_2O_5 of 33.4 kg/ha and K_2O of 197.4kg/ha. Kernels were treated with Bavistin @1.5g/kg kernel one day before sowing. Lines were drawn 30 cm apart by trench hoe and seeds were sown in furrows at equal depth maintaining a spacing of 10cm. Proper dose of herbicide was mixed well with required quantity of water and allowed to stand for 5-10 minutes and was sprayed by knapsack sprayer using a flat nozzle according to time of application. Intercultural operations were done according to the treatments. Recommended dose of fertiliser dose of 20-40-20 N, P, K was applied and all other operations were done according to the crop requirements. Monocot, dicot weeds and sedges present within a 0.5 m x 0.5 m quadrant in each net plot area were counted separately, number of weeds per m^2 was computed. The field data was subjected to statistical analysis through standard analysis of variance techniques as described in Statistical procedure for Agricultural Research" by Gomez and Gomez (1984) [3]. Standard error of means (SEm ±) and critical differences were calculated at 5% level of significance for significant treatment effect.

Results and Discussion

Weed Flora

All total, 15 different species of weeds occurred during the crop growing season. Broad leaved weeds dominated the weed population comprising of 53.5% of the total at harvest followed by grassy weeds which accounted for 40.7% and sedges accounted for 5.8% of the total at harvest (Table1). Broadleaved weeds out numbered grasses and sedges at different stages of crop growth. Amongst the grasses *Digitaria ciliaris* was the most predominant weed comprising 16.8% at 30 DAS, 16.4% at 60 DAS, 15.2% of the total population at 90 DAS and harvest. Similarly, in broad leaved weeds *Borreria hispida* was the most prominent one accounting for 30.5% at 30 and 60 DAS, 32.5% at 90 DAS and 31.7% at harvest. *Cyperus rotundus* was the only sedge found in the experimental plot, comprising of 8.8% at 30 DAS, 9.0% at 60 DAS, 6.1% at 90 DAS and 5.8%.

Table 1: Floristic composition of major weeds per m^2 area at different days after sowing

Sl. No	Scientific Name	Family	30 DAS		60 DAS		90 DAS		At harvest	
			Population	% of grand total	Population	% of grand total	Population	% of grand total	Population	% of grand total
A.	**Grassy weed**									
1	*Digitaria ciliaris*	Poaceae	38.3	16.8	51.0	16.4	44.5	15.2	39.2	15.2
2	*Digitaria sanguinalis*	Poaceae	24.8	10.9	33.5	10.8	31.0	10.6	26.8	10.5
3	*Eleusine indica*	Poaceae	24.3	10.7	32.3	10.4	30.1	10.3	26.6	10.3
4	*Dactyloctenium aegyptium*	Poaceae	7.3	3.2	11.8	3.8	10.2	3.5	9.0	3.5
5	*Panicum maximum*	Poaceae	3.0	1.3	4.0	1.3	3.5	1.2	3.1	1.2
	Total		97.7	42.9	132.7	42.7	119.3	40.8	105.0	40.7
B.	**Sedges**									
1	*Cyperus rotundus*	Cyperaceae	20.0	8.8	28.0	9.0	18.0	6.1	15.0	5.8
	Total		20.0	8.8	28.0	9.0	18.0	6.1	15.0	5.8
C.	**Broad leaved weeds**									
1	*Borreria hispida*	Rubiaceae	69.4	30.5	94.7	30.5	95.1	32.5	81.8	31.7
2	*Cleome rutidosperma*	Capparidaceae	14.6	6.4	19.9	6.4	20.5	7.0	18.1	7.0
3	*Cleome viscosa*	Capparidaceae	11.4	5.0	16.5	5.0	18.7	6.4	16.5	6.4
4	*Croton sparsiflorus*	Euphorbiaceae	5.5	2.4	7.4	2.4	7.0	2.5	6.4	2.5
5	*Eclipta alba*	Asteraceae	3.4	1.5	4.7	1.5	5.0	1.7	4.1	1.6
6	*Celosia argentea*	Amaranthaceae	2.7	1.2	3.7	1.2	4.4	1.5	3.9	1.5
7	*Phyllanthus niruri*	Euphorbiaceae	1.4	0.6	1.8	0.6	2.0	0.7	5.2	2.0
8	*Tephrosia purpurea*	Fabaceae	1.1	0.5	1.6	0.5	1.5	0.5	1.3	0.5
9	*Physalis minima*	Solanaceae	0.7	0.3	1.0	0.3	0.8	0.3	0.5	0.2
	Total		110.0	48.3	150.3	48.3	155.3	53.1	138.0	53.5
	Grand total		227.7	100.0	310.7	100.0	292.6	100.0	258.0	100.0

Effect on weed density

All the treatments were responsible for significant reduction in weed density over control. (Table 2). Oxyfluorfen @0.05kg/ha + 1HW (T_6) recorded the minimum total weed density. Application of oxyfluorfen might have killed the broad leaved seedlings and sedges through contact action and cell membrane disruption. The remaining weeds were removed through hand weeding. These results were in concurrence with Sanbagavalli *et al.* (2016) [6]. Pendimethalin @ 1kg/ha (PE) (T_1) alone as well as integration with 1 HW (T_5) considerably reduced the density of grasses. This was due to its ability to inhibit root and shoot growth of grasses. Imazethapyr@0.12kg/ha (PoE) at 20 DAS along with pre emergence herbicides (T_8 and T_{10}) considerably controlled the broad leaved weeds at 3-4 leaf stage due to its ALS inhibiting action. Similar results were observed by Kalhapure *et al.* (2013).[4] Quizalofopethyl@0.05kg/ha (PoE) at 20 DAS(T_4) was considered more effective in controlling grasses due to the fact that it is readily absorbed and translocated through the plant and inhibits the sensitive ACCaese (Acetyl Co enzyme), leading to interruption of cell membrane production in grasses. Hand weeding twice at 20 and 40 DAS (T_{12}) reduced the weed density but only to a certain extent and it was unable to give long term control. Application of any POE herbicides

without hand weeding or pre emergence herbicides resulted in poor weed control (Sagvekar *et al.*, 2015) [5]. This led to repetitive fresh flushes of weed at different stages of groundnut and more competition.

Effect on weed dry weight

It is an important measure to study the competitiveness of weeds and crops. Oxyfluorfen +1 HW (T_6) significantly reduced the total dry weight of the weeds at all stages of crop growth (Table 2). This was closely followed by pendimethalin +1 HW (T_5). The effectiveness of these two treatments might be due to season long weed control which could be approved for preventing the germination of different flushes of weeds by these herbicides and there by better growth of crop. Similar results were so observed by Sanbagavalli *et al.* (2016) [6]. Sasikala *et al*. (2013) [7] also reported similar reduction in weed dry weight due to application of oxyfluorfen + 1HW in sesamum.

Weed control efficiency

It indicates the percentage reduction in dry weight of weeds under treated plot in comparison to control plots. Best weed control efficiency was observed in oxyfluorfen +1HW (T_6) that is 84.6% over control (Table 2). The next best control efficiency was shown by pendimethalin @ 1kg (PE) +1 HW (T_5). This was due to greater reduction of broad leaved weeds, grasses and sedges at earlier stages by the herbicide which was continued by hand weeding at later stages. 2 Hand weeding at 20 and 40 DAS (T_{12}) could not provide good weed control efficiency as it was unable to control the weeds for longer period which resulted in repeated flushes of weeds.

Table 2: Weed density, dry weight of weeds and weed control efficiency as influenced by different weed management practices

Treatments	Weed Density (no./ m^2) at harvest				Weed Dry weight (g/m^2)	Weed Control Efficiency (%)
	Grasses	Sedges	BLWs	Total		
Pendimethalin @1kg/ha(PE)	4.70(21.6)	2.92(8.00)	6.79(45.60)	8.7(75.2)	9.97(99.03)	69.8
Oxyfluorfen@0.05kg/ha(PE)	3.62(12.6)	1.30(1.20)	5.76(32.67)	6.50(46.47)	7.99(63.16)	80.7
Imazethapyr@0.12kg/ha(PoE) at 20 DAS	8.61(73.6)	1.58(2.00)	7.38(54.00)	11.40(129.6)	12.85(164.74)	49.7
Quizalofopethyl@0.05kg/ha (PoE) at 20 DAS	4.49(19.67)	3.54(12.00)	10.43(108.30)	11.85(139.97)	13.59(184.3)	43.7
Pendimethalin@1kg/ha(PE)+1 HW at 20 DAS	3.94(15.00)	2.88(7.80)	5.21(26.67)	7.05(49.47)	8.1(65.21)	80.1
Oxyfluorfen@0.05kg/ha(PE)+ 1HW at 20 DAS	3.44(11.30)	0.71(0.00)	4.14(16.60)	5.33(27.90)	7.14(50.50)	84.6
Pendimethalin @1kg/ha(PE) fb Quizalfopethyl@0.05kg/ha(PoE) at 20 DAS	4.53(20.00)	3.24(10.00)	6.44(41.00)	8.45(71.00)	9.98(97.10)	70.3
Pendimethalin @1kg/ha(PE) fb Imazethapyr @0.12kg/ha(PoE) at 20 DAS	5.24(27.00)	2.24(4.50)	5.21(26.67)	7.66(58.17)	8.95(79.60)	75.7
Oxyfluorfen @0.05kg/ha(PE) fb Quizalfopethyl@0.05kg/ha(PoE) at 20 DAS	4.06(16.00)	1.87(3.00)	5.70(32.00)	7.17(51.00)	8.87(78.30)	76.1
Oxyfluorfen @ 0.05kg/ha (PE)fb Imazethapyr@ 0.12kg/ha(PoE) at 20 DAS	5.30(27.60)	1.45(1.60)	4.78(22.33)	7.22(51.63)	8.4(70.12)	78.6
Farmers Practice	5.98(35.30)	3.11(9.20)	5.73(32.3)	8.79(76.80)	9.30(86.24)	67.0
2 Hand Weeding at 20 and 40 DAS	3.94(15.00)	2.51(5.80)	5.12(25.67)	6.85(46.47)	10.41(107.96)	73.7
Weed Free	2.41(5.33)	1.22(1.00)	2.48(5.67)	3.53(12.00)	3.39(11.02)	96.6
Weedy Check	10.27(105.00)	3.94(15.00)	11.77(138.00)	5.15(26.00)	18.19(327.1)	0.0
SEm±	0.77	0.04	0.80	1.72	0.54	-
CD (P=0.05)	2.24	0.11	2.33	5.01	1.57	-

The Values in parenthesis are subjected to $\sqrt{x+0.5}$ transformation

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