Evaluation of ready mix of fluazifop and fomesafen (Fusiflex, 25 % SL) for effective weed control in Groundnut (*Arachis hypogaea*)

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ABSTRACT: To study the efficacy of ready mix of fluazifop and fomesafen (Fusiflex 25% SL) for weed control in groundnut, a field experiment was conducted in *kharif* season for two consecutive years *i.e.* 2011 and 2012 at Norman E. Borlaug Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The experimental findings revealed that the treatment fusiflex @ 500 g ai/ha, recorded efficient weed control and highest grain yield (1140.0 and 1167.3 kg/ha, respectively) during both the years but remained at par with fusiflex @ 313 g ai/ha. The increase in groundnut yield over control was 19.7% and 43.4 %, respectively during 2011 and 2012 years. Yield attributes were also found higher under these treatments. Among the herbicides applied singly, imazethapyr was found effective. *Echinochloa colona* (30 %) among grasses, 38.9 % *Phyllanthus niruri* among non-grasses and 11 % *Cyperus rotundus* among sedge were the important weed flora. Reduction in grain yield of groundnut was 22.28 % during 2011 and 48.5 % during 2012 due to weeds competition.

Key words: Fusiflex, groundnut, weeds

Groundnut holds prime importance in Indian agriculture and is the most important oilseed crop of the country both in terms of area (29% of total oilseed area) and production (36% of total oilseed production). In India, groundnut is grown in all the three seasons. The *kharif* season groundnut which is grown during the South-West Monsoon period is spread over the entire country accounting 85 % of the total area and is raised as rainfed crop. Yield reduction in groundnut is attributed to various reasons weed problem being one of them. Groundnut suffers heavily due to weed competition in early stages because of its short stature and initial slow growth. Yield reduction in ground nut has been reported at various levels by many workers from different places (Brar and Mehra, 1989; Rajah *et al*., 1984 and Subbaiah *et al.,* 1995). Yield reduction depends upon type of weeds, intensity of weeds and duration of infestation. Prusty *et al.* (1990) also reported mortality of groundnut plants due to weed competition. Yields can be reduced by 70 % if cover by weeds is > 50%. Till now weeds in groundnut crop were largely controlled either by mechanical means or by pre-emergence (PRE) herbicides like alachlor, nitrofen or by PPI herbicides *viz*. *fluchloralin, pendimethalin or trifluralin* (Sivanarayan and. Bhanumurthy, 1994). Since groundnut crop is mainly grown in *kharif* season and weeds grow luxuriantly during this season due to high moisture and temperature and also weeds generally escape various control mechanisms applied. This makes the use of some more effective post-emergence (POE) herbicides very imperative to achieve the total control of weeds. Presently used POE *viz*. imazethapyr, fomesafen are quite effective against some weeds but not very effective against broad spectrum of weeds (grasses, broad leaf weeds (BLW) and sedges) is concerned. Keeping this in mind an experiment was conducted at Norman E. Borlaug Crop Research Centre of G.B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, during *kharif* seasons of 2011 and 2012.

MATERIALS AND METHODS

The field experiment during *kharif* seasons of 2011 and 2012 was conducted at Norman E. Borlaug Crop Research Centre of G.B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand (29^0 N latitude, 79.5^0 longitude and altitude of 243.8 m above mean sea level). The soil of the experimental plot was clay loam in texture having medium organic carbon (0.68%), available phosphorus (26.6 kg P/ha) and available potassium (268 kg K/ha) contents with neutral soil reaction (pH 7.3). Fusiflex (25 % SL) is a combination of flauzifop-p-butyl 12.5% and fomesafen 12.5% SL in which flauzifop-p-butyl controls grasses and fomesafen BLW. Treatments (nine) comprising untreated check, fusiflex @ 200 g ai/ha, fusiflex @ 250 g/ha, fusiflex @ 313 g ai/ha, fusiflex 500 g ai/ha, flauzifop-P-Butyl (13.4 EC) @

125 g ai/ha, fomesafen (25 % SL) @ 250 g ai/ha, pendimethalin (30 EC) @ 750 g ai/ha and imazethapyr (10 % SL) @ 100 g ai/ha were laid in randomized block design with three replications. The groundnut variety Groundnut J-40 was sown on July, 7 during 2011 and July, 5 during 2012 with 80 kg seed/ha seed at 30 cm row spacing. The crop was nourished by 100 kg Di-ammonium phosphate (18% N and 46% P_2O_5) applied as basal dose at the time of planting. Post emergence herbicides were applied 20-25 days of crop growth (2-5 leaf stage of weeds).

Data on weed population, weed dry matter, yield and yield attributes was recorded at 60 days after sowing of crop. Data on weeds was transformed by log (X+1) transformation. Crop was harvested on November, 25 during 2011 and November, 15 during 2012.

RESULTS AND DISCUSSION

Echinochloa colona, *Eleusine indica*, *Dactyloctenium aegyptium* and *Digitaria sanguinalis* among grasses and *Commelina benghalensis, Trianthema monogyna* and *Phyllanthus niruri* among BLW were found in the experimental field. *E. colona* (30 %) among grasses and *P. niruri* (38.85%) among BLW were the predominant weeds. *Cyperus rotundus* (11 %) was the only sedge found in the experimental field (Table 1). Some other weeds like *Panicum, Mollugo pentaphylla*, *Cynodon dactylon* and *Cucumber Sp.* were also present but there number was low (10 %) and were erratic in distribution. Data given in (Table 2) revealed that at 60 days stage of crop growth. *E. colona* was major weed among all the grasses (*E. indica, D. aegyticum and D. sanguinalis*) was controlled effectively by fusiflex @ 500 g ai/ha during both the years. Population of *E. colona* was almost nill during 2011 and very small during 2012 in this treatment. Higher population of *E. colona* was recorded in weedy check which was found significantly higher over fusiflex @ 250 g ai/ha, 313 g/ha and 500 g ai/ha. Fomesafen could not perform better applied @ 250 g ai/ha. Han Tao (2011) also reported that flauzifop controlled grasses and fomesafen BLW effectively. Fomesafen used as early POE controlled BLW in groundnut and pulses. The trend was the same for all the grasses during both the years. Fomesafen was not effective against any of the grassy weeds. Initially pendimethalin @ 750 g ai/ha controlled grasses during both the years. Imazathapyr @ 100 g ai/ha also reduced the grassy weeds population during both the years. Both pendimethalin and imazathapyr also control BLW.

Highest population of *C. bengalensis* was recorded in untreated plots which was significantly higher over rest of the treatments except the Flauzifop-p-butyl @ 125 g ai/ha during both the years. *T. monogyna* and *P. niruri* population was also higher in untreated check and flauzifop @ 125 g ai/ha which was significantly higher over rest of the treatments during both the years. Fusiflex at 250, 313 and 500 g ai/ha effectively controlled all the BLW during both the years. These were also controlled effectively in the treatment imazathapyr @ 100 g ai/ha and fomesafen @ 250 g ai/ha in treated plots (Table-2).

Table 1: Dominance of different weed species before spray during 2011 and 2012

Type of the weeds	Number/m^2	% of total weeds	Number/m^2	% of total weeds
	2011		2012	
(A) Grassy Weeds				
1. *Echinochloa colona*	126.7	32.4	96.0	27.6
2. *Eleusine indica*	101.0	25.8	91.3	26.3
3. *Dactyloctenium aegyptium*	64.4	16.5	78.0	22.4
4. *Digitaria sanguinalis*	98.5	25.2	82.3	23.7
Total	390.6	-	347.6	-
(B) Non-grassy				
5. *Commelina benghalensis*	52.7	23.0	82.7	28.4
6. *Trianthma monogyna*	87.3	38.1	96.7	33.3
7. *Phyllanthus niruri*	88.8	38.8	111.2	38.3
Total	228.8	-	290.6	-
(C) Sedges				
8. *Cyperus rotundus*	120.0	16.0	41.3	6.0
(D) Other weeds	56.6	7.6	84.2	12.4
Total	739.4	-	679.5	-

Table 2: Effect of treatments on weeds (no./m^2) in groundnut during 2011 & 2012 at 60 DAS

Treatments	No. of grassy weeds/m^2					No. of BLW weeds/m^2				Other weeds	Sedges	Total weeds/ m^2
	E. colona	*E. indica*	*D. aegypti-um*	*D. sanguin-alis*	*Total grasses*	*C. benghal-ensis*	*T. monogy-na*	*P. niruri*	*Total BLW*			
				2011			2011				2011	
T1- Untreated	4.3(74.7)	3.9(50.0)	2.7(14.7)	3.5(32.0)	5.2(171.3)	2.7(14.0)	3.8(42.0)	2.6(12.7)	4.2(68.7)	3.0(20.7)	3.6(40.0)	5.6(272.0)
T2- Fusiflex @ 200 g ai/ha	3.9(46.7)	3.2(26.7)	1.4(5.3)	2.7(14.0)	4.5(92.7)	1.6(4.0)	2.7(14.0)	2.1(7.0)	3.2(23.7)	2.4(10.0)	2.5(10.7)	4.8(127.0)
T3- Fusiflex @ 250 g ai/ha	2.8(15.7)	1.9(6.3)	0.5(1.3)	1.8(5.3)	3.4(28.7)	0.8(1.3)	1.3(2.7)	1.1(2.0)	1.9(6.0)	1.3(2.7)	1.1(3.3)	3.6(38.0)
T4- Fusiflex @ 313 g ai/ha	2.3(9.3)	0.5(1.3)	0.0(0.0)	0.5(1.3)	2.5(12.0)	0.0(0.0)	1.3(2.7)	0.8(1.3)	1.1(4.0)	0.0(0.0)	0.0(0.0)	0.8(3.3)
T5- Fusiflex @ 500 g ai/ha	0.0(0.0)	0.5(1.3)	0.0(0.0)	0.4(2.0)	1.2(3.3)	0.0(0.0)	0.0(0.0)	0.8(1.3)	0.5(1.3)	0.0(0.0)	0.5(1.3)	2.8(15.6)
T6- Fluazifop-P-Butyl 13.4% EC@125g ai/ha	4.3(76.0)	1.7(4.3)	1.6(4.0)	2.1(8.0)	4.1(92.3)	2.6(12.6)	3.6(34.7)	2.2(8.0)	4.0(55.3)	0.5(0.7)	0.5(1.0)	5.0(156.3)
T7- Fomesafen (25% SL) @ 250 g ai/ha	4.5(92.0)	3.8(45.0)	2.4(11.3)	2.9(18.3)	5.1(166.6)	0.0(0.0)	0.5(0.7)	0.8(1.3)	1.1(2.0)	2.5(11.3)	3.1(23.0)	4.6(103.3)
T8- Pendimethalin (30 EC) @750g ai/ha	3.8(44.0)	3.4(31.7)	2.1(7.3)	3.3(28.3)	4.6(111.3)	1.7(4.6)	1.6(4.0)	1.1(2.0)	2.1(10.6)	2.0(7.0)	1.7(5.3)	5.2(183.7)
T9- Imazathapyr (10% SL) @100g ai/ha	3.5(33.3)	1.4(5.0)	1.1(2.7)	3.1(23.3)	4.1(64.3)	0.0(0.0)	0.8(1.3)	0.8(1.3)	1.3(2.7)	1.9(5.7)	1.8(6.3)	4.4(80.7)
SEm ±	0.3	0.4	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.2	0.3	0.3
CD at 5 %	1.0	1.2	0.9	0.9	0.8	0.6	1.1	1.0	0.8	0.5	1.0	0.8
Treatments				2012			2012				2012	
T1- Untreated	4.2(68.0)	4.1(63.3)	3.2(26.0)	3.6(35.3)	5.3(192.7)	2.7(14.0)	3.9(48.7)	3.0(20.0)	4.4(82.7)	3.4(29.3)	3.9(50.0)	5.8(325.3)
T2- Fusiflex @ 200 g ai/ha	4.0(54.0)	3.5(33.3)	2.5(13.0)	2.7(15.3)	4.8(116.0)	1.9(6.0)	2.9(18.0)	1.9(7.0)	3.4(31.0)	2.6(14.0)	2.5(10.7)	5.1(157.7)
T3- Fusiflex @ 250 g ai/ha	2.4(10.0)	2.8(16.0)	1.1(2.7)	1.8(5.3)	3.5(34.0)	1.1(2.7)	1.7(8.0)	1.1(2.7)	2.5(13.3)	1.6(4.7)	0.9(2.0)	3.8(45.3)
T4- Fusiflex @ 313 g ai/ha	2.3(9.3)	0.7(1.3)	0.7(1.3)	0.5(1.3)	2.5(13.3)	0.4(0.7)	1.1(2.7)	0.5(1.3)	1.2(4.7)	0.4(0.7)	0.5(1.3)	3.1(21.3)
T5- Fusiflex @ 500 g ai/ha	1.1(2.0)	0.0(0.0)	0.4(0.7)	0.4(0.7)	1.2(3.3)	0.0(0.0)	0.5(1.3)	0.4(0.7)	0.9(2.0)	0.0(0.0)	0.0(0.0)	1.4(5.3)
T6- Fluazifop-P-Butyl 13.4% EC@125g ai/ha	3.9(50.0)	2.4(11.7)	1.9(6.7)	2.2(8.0)	4.3(76.4)	2.9(18.0)	3.7(38.7)	2.9(18.0)	4.3(74.7)	0.5(0.7)	0.5(1.3)	2.8(18.0)
T7- Fomesafen (25% SL) @ 250g ai/ha	4.7(108.0)	3.7(46.7)	2.6(12.7)	3.1(22.6)	5.2(190.0)	0.5(1.3)	0.4(0.7)	0.9(2.0)	1.6(4.7)	2.6(12.7)	2.9(19.3)	5.4(213.3)
T8- Pendimethalin (30 EC) @750g ai/ha	3.9(51.3)	3.8(43.3)	2.7(16.0)	3.3(26.3)	4.9(136.9)	1.3(4.0)	1.1(3.3)	1.3(2.7)	2.4(10.3)	2.1(7.3)	1.6(4.7)	4.7(113.7)
T9- Imazathapyr (10% SL) @100g ai/ha	3.3(26.7)	2.5(11.7)	2.2(9.3)	3.2(24.0)	4.2(70.3)	0.5(1.3)	1.8(5.3)	0.9(20.0)	3.2(26.6)	1.9(6.0)	1.9(6.0)	4.5(89.3)
SEm ±	0.3	0.3	0.3	0.3	0.2	0.4	0.4	0.4	0.4	0.2	0.2	0.3
CD at 5 %	0.8	0.8	1.0	0.9	0.7	1.3	1.3	1.1	1.2	0.6	0.8	0.8

Table 3: Effect of treatment on growth, grain yield and during 2011 and 2012 in groundnut

Treatments	Plant height (cm.)				Dry matter of weeds g/m^2		Groundnut yield (kg/ha	
	30 DAS		60 DAS					
	2011	2012	2011	2012	2011	2012	2011	2012
T1- Untreated	3.6(34.1)	3.6(36.8)	4.0(55.1)	4.0(55.4)	5.1(161.3)	5.0(149.3)	886.1	600.8
T2- Fusiflex @ 200 g a i/ha	3.7(38.8)	3.6(37.2)	4.1(57.1)	4.0(56.2)	4.1(60.7)	3.9(54.0)	1001.7	1000.0
T3- Fusiflex @ 250 g a i/ha	3.8(45.2)	3.8(44.5)	4.1(58.2)	4.0(58.7)	3.5(32.0)	3.0(22.0)	1113.8	1100.3
T4- Fusiflex @ 313 g a i/ha	3.9(48.5)	3.9(48.5)	4.1(58.9)	4.1(63.4)	2.8(16.0)	2.7(14.0)	1134.6	1162.0
T5- Fusiflex @ 500 g a i/ha	3.7(42.6)	3.8(44.4)	4.0(56.3)	4.0(60.7)	0.4(7.0)	0.9(2.0)	1140.0	1167.3
T6- Fluazifop-P-Butyl 13.4 % EC@125g a i/ha	3.8(42.7)	3.9(48.7)	4.0(55.7)	4.1(60.6)	3.6(35.7)	3.5(31.3)	1086.6	1040.2
T7- Fomesafen (25%SL) @ 250 g a i/ha	3.6(35.8)	3.7(40.3)	4.1(56.8)	3.9(53.2)	4.1(58.7)	4.1(61.7)	982.8	988.9
T8- Pendimethalin (30 EC) @ 750 g a i/ha	3.7(39.2)	3.7(41.3)	4.1(55.8)	3.9(53.2)	3.8(44.7)	3.8(43.3)	1004.1	1060.1
T9- Imazathapyr (10%SL) @ 100 g a i/ha	3.7(40.9)	3.9(46.8)	3.7(40.8)	4.1(60.4)	3.3(26.7)	3.5(32.7)	1103.8	1010.0
SEm ±	0.4	0.3	0.3	0.2	0.2	0.2	26.6	7.8
CD at 5 %	0.1	0.8	1.0	0.5	0.5	0.7	79.6	23.4

"Other weeds" (*Cucumber, Panicum, Mollugo, Cynodon* etc.) which were very less and erratic in distribution in experimental plots number were also controlled by fusiflex @ 313 and 500 g ai/ha. Imazathapyr @ 100 g ai/ha and flauzifop-p-butyl @ 125 g ai/ha treated plots. There weeds could not be controlled effectively by pendimethalin, fomesafen and lower dose of fusiflex @ 200 g ai/ha. However the population was statistically lower then untreated during both the years. *C. rotundus* population was highest in untreated plots which was significantly higher over rest of the treatments except fusiflex @ 200 g ai/ha during 2011 and 2012. Fomesafen @ 250 g/ha was also not so effective against *C. rotundus* (Table-2).

Highest weed dry matter was recorded from untreated plot which was significantly higher over rest of the treatments during both the years. Dry matter of weeds was reduced gradually with the increase in dose of fusiflex @ 200 to 500 g ai/ha and recorded lowest in fusiflex @ 500 g ai/ha with treated plots which was significantly lower than rest of the treatments during both the years. Dry matter accumulation was similar in fusiflex @ 200 g ai/ha or fomesafen @ 250 g ai/ha in treated plots during both the years. Among individual herbicides (flauzifop, fomesafen, pendimethalin, imazathapyr). Imazathapyr produced less dry matter in weeds during both the years (Table-3).

Highest groundnut yield was recorded with fusiflex @ 500 g ai/ha with treated plots as compare to rest of the treatments except fusiflex @ 200 and 250 g ai/ha and flauzifop-p-butyl @ 125 g/ha during 2011 and over fusiflex @ 313 g/ha during 2012. Kalpana and Vellayutham (2004) also reported that among the post-emergence herbicides, imazathapyr at 100 g ai/ha performed better than chlorimuron (Kloben). Lower groundnut yield was recorded in fomesafen treated plots during both the years. This might be due to control of the grassy weeds which were more in number. Lowest grain yield was recorded from untreated plots which was significantly lower than rest of the treatments during both the years. Thus, reduction in grain yield in groundnut due to uncontrolled weeds was 22.28 % during 2011 and 48.5 % during 2012. Some suppression on crop growth due to higher dose of fusiflex @ 500 g ai/ha was observed which disappeare later on.

CONCLUSION

Reduction in groundnut yield was recorded 22.28 % during 2011 and 48.5 % during 2012. Efficient weed control and highest yield of groundnut was obtained by the application of fusiflex (flauzifop-p-butyl 12.5 % + fomesafen 12.5 %SL) @ 500 g ai/ha applied at 2-5 leaf stage of weed growth. However, since no significant differences were observed between the treatments fusiflex @ 313 g ai/ha and fusiflex @ 500 g ai/ha, hence, fusiflex @ 313 g ai/ha may be recommended for the total weed control in groundnut (*Arachis hypogaea*).

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