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Promising early post-emergence herbicides for effective weed management in soybean

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ABSTRACT

A field experiment was conducted during *Kharif* season of years 2011 and 2012 at Norman E. Borlaug crop research centre of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar (U.S. Nagar), Uttarakhand. Fluazifop-p-butyl + fomesafen controlled grasses and non-grassy weeds effectively and recorded 29.3 weeds/m^2 in 500 g/ha against (171.17/m^2) in untreated check. However, the grain yield was highest (2.21 t/ha) in the treatment of weed free followed by fluazifop-p-butyl + fomesafen applied 313 g/ha as post-emergence (2-5 leaf stage of weeds). Biomass of weeds was also lowest in fluazifop-p-butyl + fomesafen 313 g/ha treated plots. However, total weed density was lowest in fluazifop-p-butyl + fomesafen 500 g/ha treated plot but this dose showed toxic effects on crop. Weed index was lowest (7.8%) in the treatment of fluazifop-p-butyl + fomesafen 313 g/ha and highest in untreated (63.5%).

Key words: Chemical control, Fluazifop-p-butyl + fomesafen, Soybean, Weed management

Soybean (*Glycine max* L. Merril) grown in *Kharif* season is heavily infested with weeds due to high moisture and temperature. Yield reduction due to uncontrolled weeds in soybean has been recorded to the tune of 30-80% depending upon type of weeds and duration of infestation, besides yield losses. Depletion of 26-65 kg N/ha, 3-11 kg P_2O_5 and 45-102 kg K_2O was also reported by Yaduraju (2002). Tewari and Trivedi (1985) suggested that soybean yield can be enhanced by almost 50% by adopting timely chemical weeding. Some weed species escape with the application of pre-emergence or pre-plant incorporated herbicides by one way or another. Malik *et al. (*2006) suggested that sequential application of herbicides may provide more consistent weed control than single application. Many times due to continuous rains, application of pre-emergence application of herbicides is not feasible. Keeping the facts in mind, an experiment was conducted to assess the efficacy of fluazifop-p-butyl + fomesafen (125 g +125 g) (Fusiflex 25% SL) (early post emergence applied at 2-5 leaf stage of weeds) in managing weeds in soybean.

MATERIALS AND METHODS

A field experiment was conducted at Norman E. Borlaug crop research centre of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar (U.S. Nagar), Uttarakhand, India during *Kharif* season of 2011 and 2012. Pantnagar lies in the Tarai region to the South of foot hills of the Shivalik Himalayas at 29^0N latitude and 79.3^0E longitudeand at an altitude of 243.83 m above mean sea level. Fluazifop-p-butyl + fomesafen (25% SL) is a combination of flauzifop-p-butyl and fomesafen in which flauzifop-p-butyl control grassy and fomesafen control non-grasses in pulses particularly in soybean. Ten treatments, *viz*. control, fluazifop-p-butyl + fomesafen 200, 250, 313 and 500 g/ha, flauzifop-p-butyl 125 g/ha, fomesafen 250 g/ha, emazathapyr 100 g/ha, chlorimuron-ethyl 9.0 g/ha and weed free were replicated thrice in a randomized block design. Soybean seed (60 kg/ha) of variety '*PS-1042*' was sown on 8 July, 2011 and 10 July, 2012 at 45 cm row to row distance. Crop was nourished with 100 kg DAP/ha and was applied at the time of sowing as basal. Data on weeds (weed density, weed biomass) were transformed as log Crop was harvested on 5 November, 2011 and 10 November, 2012. All the herbicides were applied as post-emergence at 20-25 days after sowing of crop (2-5 leaf stage of weeds). Total rainfall received during crop season was 1799 mm during 2011 and 885.6 mm during 2012. Experimental soil was silty, rich inorganic carbon (1.05%) and medium in available P_2O_5 (49.0 kg/ha) and K_2O (240.4 kg/ha) with neutral reaction pH (7.3).

RESULTS AND DISCUSSION

Major weed species in soybean field were *Echinochloa colona* (36.2% during 2011 and 36.0% during 2012), *Eleusine indica* (76.6% during 2011 and 31.6% during 2012), *Dactyloctenium aegyptium* (16.8% during 2011 and 12.9% during 2012), *Digiteria*

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sanguinalis (19.5% during 2011 and 19.4% during 2012) among grasses. Among non-grasses, *Trianthma monogyna* (54.0% during 2011 and 47.0% during 2012), *Commelina benghalensis* (28.7% during 2011 and 25.8% during 2012) *Phyllanthus niruri* (17.4% in 2011 and 24.1 in 2012) were pre-dominant species before spraying. *Cyperus rotundus* (14.0% in 2011 and (15.0% in 2012) was the only sedges (Table 1).

Grasses were controlled effectively by fluazifop-p-butyl + fomesafen 313 g/ha (applied at 2-5 leaf stage of weeds). Fomesafen 250 g/ha and chlorimuron-ethyl 9.0 g/ha were effective control against broad-leaved weeds. Grasses were recorded in higher weedy (untreated plot) which was significantly higher over rest of the treatments except flauzifop-p-butyl applied 125 g/ha, fomesafen 250 g/ha and chlorimuron-ethyl 9.0 g/ha. Balyan *et al.* (2003) also reported that grassy weeds could not be controlled by fomesafen. Higher density (53.0 m^2) of non-grasses was recorded in weedy check which was significantly higher over rest of the treatments except chlorimuron-ethyl and fomesafen. *Cyperus rotundus* was controlled effectively by fluazifop-p-butyl + fomesafen 250 g/ha, 313 g/ha, 500 g/ha and chlorimuron-ethyl. Lowest weed density was recorded in the treatment of fluazilop-p-butil + fomesafen 313 g/ha.

Among grasses, all the grassy, weeds were controlled effectively by fluazifop-p-butyl + fomesafen. However, the rate of control was differential in different rates of application. Lowest density of *Echinichloa colona, Elusine indica, Dectyloctenium aegypticum* and *Digiteria sanguinalis* were controlled effectively at 500 g/ha treated plots. These grasses could not be controlled by fomesafen (250 g/ha), chlorimuron-ethyl (9.0 g/ha). Grasses were also controlled by imazathapyr (10% SL) applied 100 g/ha during both the years. Non-grasses, *viz. Commelina benghalensis*, *Trienthma monogyna* and *Phyllanthus niruri* were controlled completely in the fluazifop-p-butyl + fomesafen applied 500 g/ha during both the years. *Commelina benghalensis* was recorded highest in untreated plots which was significantly higher over rest of the treatments except flauzifop-p-butyl 125 g/ha during both the years. Weed biomass (g/m^2) at 60 days stage was highest in weedy check which was found significantly higher over rest of the treatments except fluazifop-p-butyl + fomesafen 200g/ha and chlorimuron-ethyl (Table 2). Biomass of weeds was reduced with the increase in rate of application of fluazifop-p-butyl + fomesafen 200 to 500 g/ha. Lowest weed biomass was recorded in the treatment of fluazifop-p-butyl + fomesafen 500 g/ha which was significantly lower over rest of the treatments. Among all the treatments, weed control efficiency was recorded highest in fluazifop-p-butyl + fomesafen 500 g/ha treated plots during both the years.

Lowest grain yield was recorded in untreated plots which were significantly lower than rest of the treatments during both the years. Highest grain yield was recorded in weed free plots which was significantly higher over rest of the treatments except the treatment of fluazifop-p-butyl+ fomesafen 313 g/ha during both the years. Reduction in grain yield due to uncontrolled weeds was recorded 61.82% during 2011 and 61.78% during 2012. The grain yield of soybean was increased as the rate of application of fluazifop-p-butyl + fomesafen was increased 200 g/ha to 313 g/ha and reduction in yield was recorded at 500 g/ha

Table 1. Weed density and biomass of weeds as influenced by fluazifop-p-butyl + fomesafen in soybean (average of two years)

Treatment	Total weed density at 60 DAS (no./m^2)				Weed biomass at 60 DAS (g/m^2)
	Grasses	Non-grasses	Sedges	Total	
Fluazifop-p-butyl+ fomesafen 200 g/ha	3.6(37.3)	3.3(26.7)	2.9(18.3)	3.4(100.4)	5.3(200.9)
Fluazifop-p-butyl+ fomesafen 250 g/ha	3.2(43.0)	2.4(10.7)	2.7(14.7)	3.1(66.7)	4.9(162.0)
Fluazifop-p-butyl+ fomesafen 313 g/ha	2.8(15.7)	1.7(5.0)	2.5(11.3)	2.8(49.7)	4.7(136.4)
Fluazifop-p-butyl+ fomesafen 500 g/ha	3.4(24.3)	3.3(28.0)	2.9(17.2)	2.2(29.3)	5.0(132.0)
Fluazifop-p-butyl 125 g/ha	3.7(43.0)	3.3(27.3)	2.8(17.0)	3.3(80.3)	5.1(166.5)
Fomesafen 250 g/ha	3.8(44.3)	3.5(34.7)	3.0(20.0)	3.5(105.0)	5.2(189.4)
Imazathapyr 100 g/ha	3.4(31.7)	3.1(23.3)	2.9(17.0)	3.2(78.0)	5.1(172.7)
Chlorimuron-ethyl 9.0 g/ha	4.0(58.3)	3.8(43.0)	3.2(25.0)	3.7(133.7)	5.3(219.9)
Weed free	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Untreated	4.3(76.0)	3.98(53.0)	3.2(25.3)	4.0(171.7)	5.6(274.8)
LSD (P=0.05)	0.6	0.6	0.4	0.3	0.3

Original data has been shown in parentheses; Data on weeds was transformed in log

Table 2. Yield and yield attributes influenced by various treatments (average of two years)

Treatment	No. of pods/ plant	No. of seeds/ pod	1000-seed weight	Seed yield (t/ha)	Weed index (%)	Oil content (%)	Protein content (%)
Fluazifop-p-butyl+ fomesafen 200 g/ha	60.2	2.4	121.9	1.63	26.1	20.10	39.46
Fluazifop-p-butyl+ fomesafen 250 g/ha	69.4	2.4	122.7	1.86	15.8	21.13	40.49
Fluazifop-p-butyl+ fomesafen 313 g/ha	72.9	2.4	123.0	2.03	7.8	21.14	40.72
Fluazifop-p-butyl+ fomesafen 500 g/ha	60.0	2.4	114.6	1.85	16.1	19.83	39.87
Fluazifop-p-butyl 125 g/ha	63.1	2.4	121.1	1.77	19.7	20.13	40.20
Fomesafen 250 g/ha	58.1	2.4	119.9	1.61	27.3	19.20	39.74
Imazathapyr 100 g/ha	68.1	2.4	121.4	1.85	15.9	20.50	39.66
Chlorimuron-ethyl 9.0 g/ha	58.4	2.4	118.9	1.52	31.2	19.63	38.18
Weed free	77.0	2.4	124.0	2.21	0.0	21.26	41.85
Untreated	45.9	2.2	118.0	0.81	63.5	18.26	37.97
LSD (P=0.05)	2.7	NS	3.54	0.18	8.0	0.49	NS

application of fluazifop-p-butil + fomesafen during both the years. The lower yield in fomesafen might be due to non controlling of grasses by this herbicide. Whereas flauzifop-p-butyl controlled grasses effectively which were more in number and biomass of total weeds was also higher in, fluazifop-p-butil + fomesafen treated plots during both the years. Numbers of pods/plant were highest in weed free plots and found significantly higher over rest of the treatments (Table 2). Number of pods/plant were increased as the application rate of fluazilop-p-butil + fomesafen was increased 200 to 313 g/ha, however, highest rate (500 g/ha) the number of pods/plant were reduced. Lowest pods/plant was recorded in weedy check. Though, number of seeds/plant was non-significant, weight of 1000 seeds was also higher in weed free which was significantly higher over rest of the treatments except the treatment chlorimuron-ethyl (9.0 g/ha), fomesafen 250 g/ha, fluazilop-p-butil + fomesafen 500 g/ha and weedy check. Protein content was also recorded higher in weed free treatment. Oil content was lowest in untreated plots and was increased in the treatment of fluazifop-p-butyl + fomesafen applied at 200 g/ha to 313 g/ha and decreased in higher rate of fluazifop-p-butyl + fomesafen applied (500 g/ha). Highest oil content was recorded in weed free treatment which was found significantly higher over rest of the treatments except fluazifop-p-butyl + fomesafen 313 g/ha. Lowest oil content was recorded in untreated check (Table 2).

It may be concluded that fluazifop-p-butyl + fomesafen 313 g/ha is a broad spectrum herbicide to control weeds in soybean applied as an early post-emergence (2-5 leaf stage of weeds). Flauzifop-p-butyl controlled almost all the grasses whereas fomesafen controlled non-grasses effectively.

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