ISSN 2319-6432 (Print)
ISSN 2349-6433 (Online)

J Krishi Vigyan 2024, 12(4) : 749-756

DOI : 10.5958/2349-4433.2024.00130.7

Bio Efficacy and Phytotoxicity Evaluation of Premixed Fomesafen plus Quizalofop Ethyl for Weed Control in Soybean

D S Tomar [1], Rekha Tiwari[2] and Ghazala Khan[3]
Krishi Vigyan Kendra, (Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya)
Ujjain 456 010 (Madhya Pradesh)

ABSTRACT

Soybean is the most important oil seeds crop in many states of the country as a rain fed crop in *kharif* season, in terms of total production and international trades. However, losses due to weeds have been one of the major limiting factors in soybean production. So, successful weed control is one of the most important practices for economical soybean production. An experiment was laid out at the instructional farm of Krishi Vigyan Kendra, Ujjain to evaluate the efficacy of premix herbicide which could control both the grassy and broad leaf weeds. Use of fomesafen 12 % + quizalofop 3% w/w SC at different concentrations ranging from 1125 to 3000 ml ha^{-1} as post emergence reduced the weed density, increased weed control efficiency and yield apart from no phototoxic effect on plants and succeeding crop of garden pea.

Key Words: Soybean, Phyto-toxicity, Pre-mix Herbicides, Weed Density, Weed Control Efficiency.

INTRODUCTION

Madhya Pradesh is a leading state in India for cultivation of soybean, where it is grown on 5.51 million hectares with the total production of 5.15 million tons. But the productivity is 934 kg/ha which is far below than its yield potential *i.e.* 2500 kg/ha (SOPA, 2023). Soybean [*Glycine max* (L.) Merrill] is an important grain legume crop, which has ability not only to fix nitrogen for its own use but also leave some residual nitrogen for the succeeding crop. It is grown in *Kharif* season and thus weed management plays an important role for its successful cultivation. Depending upon the nature, density and period of occurrence of weeds, they can cause loss of 35-80% in yield. Wadafale *et al* (2011) and Kamble *et al* (2017) observed that the critical period of crop-weed competition in soybean crop was 30-40 days after sowing (DAS). Keeping the crop weed free through manual weeding and hoeing, though effective, but has several limitations such as timely availability of adequate labour and difficulty in using mechanical weeders during rainy season etc. The only and the best alternative, therefore, seem to be application of herbicides at proper time and optimum dose. The herbicides applied as pre-emergence may fail to provide weed control for the entire growing season due to herbicide dissipation in the dry weather conditions. The stress is mainly due to presence of dominating grassy weeds viz; *Echinochloa crusgalli, Echinochloa colona, Cyperus spp. Cynodon dactylon* and broad leaved weeds viz; *Commelina benghalensis, Commelina communis, Phyllanthus niruri,Euphorbia spp.* and *Corcorus acutangulus* etc. (Sharma and Shrivastava, 2002). If weeds are not controlled during critical period of crop-weed competition during the initial 20-45 days, there is severe reduction in the yield of soybean ranging from 58 to 85 per cent, depending upon the types and intensity of weeds (Kewat *et al.,* 2000). According to Kundu *et al* (2011) the loss in yield of soybean due to weeds was 43% in control which indicates the necessity of controlling weed for exploiting the yield potential of soybean. Therefore, it is necessary to control weeds during this period as they compete for nutrients, moisture, and light so as to obtain maximum fertilizer and water use efficiency.

Competition between crops and weeds generally begin at the early stages after emergence

Corresponding Author's Email - ekhaup_2007@rediffmail.com

Table 1. Physico-chemical properties of soil of the of the experimental field.

Property	Quantity
A) Mechanical composition	
Sand (%)	19.35
Silt (%)	32.42
Clay (%)	48.23
Textural class	Clayey, Vertisol
B) Chemical properties	
pH	7.80
Organic carbon	0.40 (%)
Electrical conductivity	0.33 (d/Sm)
Available Nitrogen	201.72 (kg/ha)
Available Phosphorus	27.80 (kg/ha)
Available Potash	490.5 (kg/ha)

of the crop. If the weeds are checked during this period, the soybean gets an advantage over the weeds and smothers them afterwards. To overcome the deleterious effects of weeds in soybean, it is imperative that weeds population be kept below the economic threshold level. In soybean, weed is generally managed through manual weeding and hoeing but due to intermittent rainfall during rainy season and scanty labour, timely inter culture becomes a very difficult task. Adverse weather conditions also limit the use of tools and implements for clearing weeds in the field. Under such situations, different pre and post-emergence herbicides can control annual grass and broad-leaved weeds effectively in soybean. The present study was carried out to evaluate the efficacy of fomesafen 12 % + quizalofop ethyl 3% w/w SC weed control and effect on growth and yield of soybean.

MATERIALS AND METHODS

The present experiment was carried out at the instructional KVK Farm, Krishi Vigyan Kendra, and RVSKVV at Ujjain during *Kharif* season of 2021 to 2023.

Experimental Site, Weather and Soil

Ujjain is situated in the *Malwa* Agro Climatic Zone in west Madhya Pradesh, lies between $25^0264'$ North latitude and $82^0 99.3'$ East longitudes at an elevation of 129.23 m above mean sea level. The soil of experimental field is clayey commonly categorized as Vertisol of good fertility. Soil samples up to 30 cm, depth was collected prior to application of treatments from 20 places and analysis of physico-chemical properties of the soil is presented in Table 1.

A very promising cultivar of Soybean cv. RVS-24" was used for the present study. It takes 92-98 days for maturity. All the plots received uniform cultural operations throughout the experimental period and the whole of the experimental field was kept clean and well maintained. The amount of fertilizers and manures were applied uniformly under all the treatments as per the Recommended Dose of Fertilizers (RDF) 20:60:40:20 NPKS was applied. The details of the nine treatments related to herbicides are listed below applied in randomized block design (RBD). In all three replications were taken with a plot size of 6.6 m ×2.6 m and the crop were sown in rows 45 cm apart. After the harvest of this crop garden pea was sown in these plots to study the residual nature of the herbicides. The herbicide treatments were applied at 3 to 4 compound leaf stage of soybean and / or 2 to 3 leaf stage of weeds under observation. For this the appropriate herbicide solution was prepared and diluted in 400 lt of water and applied with the help of knapsack sprayer having cut throat nozzle.

Table 2. Details of the treatments.

Tr. No.	Treatment	Doses ml/ha	Dilution in water (litre/ha)
T_1	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC	1125	500
T_2	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC	1500	500
T_3	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC	1875	500
T_4	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	500
T_5	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	500
T_6	Quizalofop Ethyl 10% EC (Market sample)	375	500
T_7	Imazethapyr 10% SL	1000	500
T_8	Weed free check(hand weeding at 20 and 40 days after sowing)	–	500
T_9	Weedy check (Untreated control)	–	500
T_{10}	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000	500

Observations recorded

Per cent weed control efficiency

Based on weed dry weight per cent weed control efficiency over control (weedy check) was also calculated for each weed species using following formula:

$$WCE\ (\%) = \frac{\text{Dry matter of weeds in un-weeded plot} - \text{Dry matter of weeds in treated plot}}{\text{Dry matter of weeds in un-weeded plot}} \times 100$$

Phytotoxicity

Phytotoxicity was recorded visually for leaf injury on tips/surface, wilting, vein clearing, necrosis, epinasty and hyponasty. The observations were recorded at 10, 20, 30, 45 and 60 days after treatment application for all the treatments. The scale 1-10 was followed to record observations for leaf injury on tips/ surface.

Yield and yield traits

The observations were also recorded for treatment No. 1 to 8 on grain yield/plot (kg) at harvest and converted into grain yield (q/ha).

Residual effect on succeeding crop

For analyzing the residual effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC applied in soybean crop on the succeeding crop, garden pea was grown in the same plots without disturbing the original layout plan of the experiment. Observation was recorded on crop germination percentage. Observations for phytotoxicity parameters were also recorded periodically.

Phytotoxicity Rating Scale (PRS)

Crop response / crop injury	Rating
0-10%	1
11-20%	2
21-30%	3
31-40%	4
41-50%	5
51-60%	6
61-70%	7
71-80%	8
81-90%	9
91-100%	10

Statistical analysis

The observations recorded during the course of investigation were subjected to statistical analysis by adopting appropriate Model *i.e.*, "Analysis of variance" as per the procedure described by Panse and Sukhatme (1985) after subjecting to requisite transformation. Critical difference (CD) was calculated in order to compare the treatment at 5% level of significance.

RESULTS AND DISCUSSION

The data pertaining to effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on number of weeds at various crop stage viz., 15, 30 and 60 DAS (Days after crop sowing) during 2021-2023 were recorded and pooled using 100 cm x 100 cm quadrat placing at random at four places per plot and aggregate weed density was expressed on per m^2 basis. The data are presented in Table 3 to 5. The major weed species recorded in the experimental plots at different time intervals were *Echinochloa colonum* (Jungle Rice), *Echinochloa crusgalli* (Cockspur), *Digiteri sanguinalis* (Hairy crabgrass), *Dactyloctenium aegyptium* (Crow foot grass) and *Eleucine indica* (*Goose grass*), whereas *Phalaris minor* (Canary grass) was not present in the field during entire period.

After 15 days of crop sowing dominant weeds observed were *Echinochloa colonum* (Jungle Rice), *Echinochloa crusgalli* (Cockspur), *Digiteria sanguinalis* (Hairy crabgrass), *Dactyloctenium eigiptium* (Crow foot grass) and *Eleucine indica* (*Goose grass*). The population of these weeds was significantly low in the treatment of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Best Crop sample) @ 750 ml/ha followed by Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample) @ 750 ml/ha. The weed population in untreated control (weed free) was at par to untreated control (weedy check) as by that time hand weeding was not done. However, at 30 DAS all the treatments were found significantly effective to control these weeds as compared to untreated control (weedy check). Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Best Crop sample) @ 750 ml/ha was most effective after untreated control (weed free check) followed by Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample) @ 750 ml/ha. Fomesafen 12 % + Quizalofop ethyl 3% w/w SC applied @ 1000 ml/ha was also effective when compared to untreated control (weedy check). Similar trend of effectiveness of these treatments was observed at 30 and 60 DAS.

The weeds *Phalaris minor* (Canary grass) was not observed at 15 to 60 DAS in any of experimental plots. The results thus showed that untreated control (weed free) and Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Best Crop sample) @ 750 ml/ha, and Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample) @ 750 ml/ha effectively controlled these weeds. Fomesafen 12 % + Quizalofop ethyl 3% w/w SC applied @ 1000 ml/ha was also effective when compared to untreated control (weedy check). Overall, the herbicide treatments effectively controlled and checked the growth of weeds in soybean crop.

Weed control efficiency (WCE) at various crop stages

The weed control efficiency calculated over control (weedy check) based on weed dry weight recorded at various time intervals are presented in Table 6 and 7. The results showed that all the treatments were quite effective to control the weeds at each time interval of observations. The weed control efficiency in untreated control (weed free) was lower as compared to other treatments. Amongst the other treatments Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Best Crop sample) @ 750 ml/ha and Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample) @ 750 ml/ha effectively controlled the weeds growth. Fomesafen 12 % + Quizalofop ethyl 3% w/w SC applied @ 1000 ml/ha was also effective when compared to untreated control (weedy check).

Yield

The data pertaining to grain yield of soybean are presented in Table 8. The observations recorded for grain yield q/ha was higher in the treatment of untreated control (weed free) and Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Best Crop sample) @ 750 ml/ha. Fomesafen 12 % + Quizalofop ethyl 3% w/w SC

Table 3. Effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on number of weeds at various crop stage of soybean

Treatment		Dose ml/ha	*Echinochlo acolonum* (Jungle Rice)			*Echinochloa crusgalli* (Cockspur)			*Digiteria sanguinalis (Hairy crabgrass)*			*Dactyloctenium eigiptium (Crow foot grass)*		
			15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS
T1	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1125	3.19 (9.33)	3.10 (8.67)	3.10 (7.33)	2.70 (6.30)	2.99 (8.0)	3.45 (11)	2.36 (4.7)	2.94 (7.7)	3.33 (10.3)	1.82 (2.3)	2.48 (5.30)	2.87 (3.3)
T2	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1500	2.93 (7.66)	2.76 (6.67)	2.76 (5.33)	2.57 (5.70)	3.09 (8.67)	2.46 (3.33)	1.82 (2.3)	1.71 (2.0)	2.88 (6.0)	1.71 (2.0)	2.06 (3.30)	2.88 (6.3)
T3	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1875	2.82 (7.0)	3.09 (867)	3.09 (6.0)	2.36 (4.70)	2.36 (4.67)	2.87 (7.33)	1.71 (2.0)	1.68 (2.0)	3.20 (9.3)	2.22 (4.0)	1.93 (3.0)	1.71 (3.0)
T4	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	2.91 (7.6)	2.94 (7.67)	2.94 (6.67)	2.49 (5.3)	2.57 (5.67)	2.48 (5.33)	1.71 (2.0)	1.52 (1.3)	2.81 (7.7)	2.15 (3.7)	2.42 (5.0)	2.64 (8.3)
T5	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	3.45 (11)	3.45 (11)	3.45 (15.0)	3.09 (8.7)	2.75 (6.67)	2.275 (6.67)	2.06 (3.3)	2.15 (3.7)	2.45 (6.3)	2.33 (4.7)	1.82 (2.3)	2.36 (4.3)
T6	Quizalofop Ethyl 10% EC Market sample)	375	3.9 (14.3)	3.74 (13)	3.74 (13.67)	2.93 (7.7)	2.75 (6.67)	2.27 (4.33)	2.06 (3.3)	1.73 (2.0)	2.35 (3.0)	1.80 (2.3)	1.52 (1.3)	1.38 (3.7)
T7	Imazethapyr 10% SL	1000	4.38 (18.3)	4.16 (16.33)	4.16 (13.0)	3.94 (14.7)	4.23 (17)	5.27 (27.0)	2.81 (7.0)	2.93 (7.7)	2.76 (8.7)	2.49 (5.3.)	2.57 (5.7)	3.04 (7.7)
T8	Weed free check (hand weeding at 20 and 40 days after sowing)		1.97 (3)	2.15 (3.70)	2.15 (3.33)	1.64 (2.0)	1.38 (1.0)	2.42 (5.0)	(1.0)	1.41 (1.0)	3.04 (3.7)	1.13 (0.3)	1.14 (0.3)	1.38 (4.3)
T9	Weedy check (Untreated control)		7.34 (55.3)	8.26 (67.7)	8.26 (215)	6.96 (47.7)	6.51 (41.7)	4.73 (21.67)	4.38 (18.3)	5.76 (32.3)	4.04 (27.0)	3.90 (14.0)	4.81 (22.3)	5.15 (18.0)
T10	Fomesafen 12% + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000							1.13 (0.3)	1.41 (3.2)	1.13 (0.3)	1.14 (0.3)	1.13 (0.3)	1.14 (0.7)
	CD 5%		1.31	0.507	0.507	0.564	0.320	0.662	0.476	0.430	NA	0.489	0.664	NS
	Result		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	NS
	Figure in parentheses are original values which are subjected to square root transformation √(x+0.5) DAS – days after crop sowing													

(Market sample) @ 750 ml/ha and Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Best Crop sample) @ 1000 ml/ha was also effective as compared to untreated control (weedy check). The highest yield qt per hectare was obtained in T8 (19.73) whereas among the herbicidal treatments the highest yield of 18.2 and 18.1 was recorded in T4 and T2, although they were statistically at par. Among the herbicide treatments T5 (15.53) recorded the lowest yield, probably due to regular use of Imazethapyr over the last 3 decades, thus inducing resistance towards the efficacy on major weeds. Similar results were earlier reported by Kewat *et al* (2000) and Sharma *et al* (2002).

CONCLUSION

The investigations revealed that Fomesafen 12 % + Quizalofop ethyl 3% w/w SC applied @ 750 to 1000 ml/ha was effective to control weeds in soybean crop. No phytotoxicity of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC applied @ 1500, 1000, 750 and 500 ml/ha to soybean crop and no residual effect on germination of succeeding crop was observed. The germination percentage of the succeeding pea crop ranged from 81.6 to 88 per cent which can be attributed to be normal as per the germination standards prescribed in Indian minimum seed certification standards. Based on the study, the use of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC @ 750 ml/ha is suggested for the control of weeds in soybean crop which is at par with Market sample of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC.

Table 4. Effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on number of weeds at various crop stage of soybean

Treatment		Dose ml/ha	*Eleucine indica* (Goose grass)			*Phalaris minor* (Canary grass)			*Echinochloa colonum* (Jungle Rice)			*Echinochloa crusgalli* (Cockspur)		
			15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS
T_1	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1125	1.72 (2.3)	2.15 (3.7)	2.36 (3.0)	NIL NIL	NIL NIL	NIL NIL	2.72 (6.43)	2.89 (7.4)	3.37 (10.39)	2.66 (6.13)	2.36 (4.59)	2.89 (7.40)
T_2	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1500	1.66 (2.0)	1.82 (2.3)	2.15 (3.7)	NIL NIL	NIL NIL	NIL NIL	2.54 (5.47)	2.69 (6.3)	3.13 (8.83)	2.49 (5.21)	2.21 (3.90)	2.69 (6.28)
T_3	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1875	1.48 (1.3)	2.06 (3.3)	2.50 (5.3)	NIL NIL	NIL NIL	NIL NIL	2.76 (6.67)	2.94 (7.7)	3.42 (10.76)	2.70 (6.34)	2.39 (4.75)	2.94 (7.66)
T_4	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	1.66 (2.0)	1.95 (3.0)	2.33 (4.7)	NIL NIL	NIL NIL	NIL NIL	2.22 (3.93)	2.35 (4.5)	2.71 (6.35)	2.17 (3.75)	1.95 2.80	2.34 (4.52)
T_5	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	1.79 (2.7)	1.91 (2.7)	2.69 (6.3)	NIL NIL	NIL NIL	NIL NIL	1.98 (2.93)	2.09 (3.4)	2.39 (4.74)	1.91 (2.79)	1.75 (2.09)	2.09 (3.37)
T_6	Quizalofop Ethyl 10% EC Market sample)	375	1.48 (1.3)	1.62 (1.7)	1.82 (2.3)	NIL NIL	NIL NIL	NIL NIL	2.06 (3.27)	2.17 (3.8)	2.50 (5.27)	2.02 (3.11)	1.82 (2.33)	2.17 (3.76)
T_7	Imazethapyr 10% SL	1000	2.16 (4.0)	2.42 (5.0)	3.25 (9.7)	NIL NIL	NIL NIL	NIL NIL	2.67 (6.17)	2.84 (7.1)	3.30 (9.96)	2.62 (5.87)	2.32 (4.40)	2.84 (7.09)
T_8	Weed free check(hand weeding at 20 and 40 days after sowing)	-	1.47 (1.3)	1.33 (1.0)	1.82 (2.3)	NIL NIL	NIL NIL	NIL NIL	1.26 (0.6)	1.29 (0.7)	1.39 (0.57)	1.25 (0.57)	1.19 (0.43)	1.29 (0.69)
T_9	Weedy check (Untreated control)	-	3.0 (8.7)	3.70 (13.3)	2.94 (25.0)	NIL	NIL	NIL	3.7 (12.7)	3.94 (14.6)	4.63 (20.56)	3.61 (12.13)	3.17 (9.08)	3.94 (14.64)
T_{10}	Fomesafen 12% + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000	1.41 (1.3)	1.24 (0.7)	1.24 (2.3)	NIL	NIL	NIL	1.04 (0.6)	1.04 (0.1)	1.06 (0.14)	1.04 (0.08)	1.02 (0.06)	1.04 (0.10)
	CD 5%		0.588	0.643	NA	NIL	NIL	NIL	0.227	0.245	0.298	0.220	0.185	0.245
	Result		Sig	Sig	NS	NIL	NIL	NIL	Sig	Sig	Sig	Sig	Sig	Sig

Table 5: Effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on number of weeds at various crop stage of soybean

Treatment		Dose ml/ha	*Digiteria sanguinalis* (Hairy crabgrass)			*Dactyloctenium eigiptium* (Crow foot grass)			*Eleucine indica* (*Goose grass*)		
			15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS
T_1	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1125	2.43 (4.93)	2.16 (3.70)	2.15 (3.64)	2.53 (5.43)	2.26 (4.11)	2.22 (3.97)	2.42 (4.88)	2.21 (3.91)	2.12 (3.49)
T_2	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1500	2.15 (3.63)	1.86 (2.47)	1.84 (2.41)	2.35 (4.00)	1.93 (2.75)	1.90 (2.62)	2.14 (3.6)	1.90 (2.61)	1.81 (2.31)
T_3	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1875	1.98 (2.93)	1.81 (2.29)	1.78 (2.19)	2.05 (3.23)	1.88 (2.54)	1.83 (2.38)	1.97 (2.90)	1.84 (2.42)	1.76 (2.10)
T_4	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	2.10 (3.43)	1.84 2.4	1.82 (2.34)	2.18 (3.78)	1.91 (2.67)	1.88 (2.55)	2.09 (3.40)	1.88 (2.54)	1.80 (2.24)
T_5	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	2.34 (4.5)	2.01 (3.06)	2.09 (3.41)	2.43 (4.95)	2.09 (3.40)	2.16 (3.71)	2.33 (4.46)	2.05 (3.23)	2.06 (3.27)
T_6	Quizalofop Ethyl 10% EC Market sample)	375	2.42 (4.88)	2.23 (4.00)	1.93 (2.76)	2.52 (5.36)	2.33 (4.45)	2.00 (3.01)	2.41 (4.83)	2.28 (4.22)	1.90 (2.65)
T_7	Imazethapyr 10% SL	1000	2.71 (6.40)	2.57 (5.63)	2.68 (6.22)	2.83 (7.04)	2.69 (6.26)	2.78 (6.78)	2.70 (6.34)	2.63 (5.95)	2.63 (5.96)
T_8	Weed free check(hand weeding at 20 and 40 days after sowing)		1.29 (0.67)	1.23 (0.53)	1.11 (0.24)	1.31 (0.73)	1.26 (0.59)	1.12 (0.27)	1.28 (0.66)	1.25 (0.56)	1.11 (0.23)
T_9	Weedy check (Untreated control)		3.56 (11.73)	3.97 (14.76)	4.97 (23.76)	3.72 (12.91)	4.17 (16.41)	5.18 (25.9)	3.55 (11.62)	4.07 (15.59)	4.87 (22.79)
T_{10}	Fomesafen 12% + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000	1.05 (0.11)	1.03 (0.08)	1.02 (0.06)	1.05 (0.12)	1.04 (0.09)	1.03 (0.06)	1.05 (0.11)	1.03 (0.08)	1.02 (0.05)
	CD 5%		0.111	0.097	0.111	0.117	0.104	0.117	0.110	0.100	0.108
	Result		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
	Figure in parentheses are original values which are subjected to square root transformation **(x+0.5) DAS – days after crop sowing**										

Bio Efficacy and Phytotoxicity Evaluation

Table 6: Effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on per cent weed control efficiency (WCE) at various crop stage of soybean.

Treatment		Dose ml/ha	*Echinochloa colonum* (Jungle Rice)			*Echinochloa crusgalli* (Cockspur)			*Digiteriasang uinalis (Hairy crabgrass)*			*Dactyloctenium eigiptium (Crow foot grass)*		
			15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS
1.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1125	49.5	49.5	57.1	49.5	49.5	51.9	58.0	74.9	84.7	58.0	74.9	84.7
2.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1500	57.1	57.1	63.7	57.1	57.1	59.1	69.0	83.3	89.9	69.0	83.3	89.9
3.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1875	47.6	47.6	57.8	47.6	47.6	50.1	75.0	84.5	90.8	75.0	84.5	90.8
4.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	69.1	69.1	71.1	69.1	69.1	70.6	70.7	83.7	90.2	70.7	83.7	90.2
5.	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	77.0	77.0	79.3	77.0	77.0	78.1	61.6	79.3	94.5	61.6	79.3	85.7
6.	Quizalofop Ethyl 10% EC Market sample)	375	74.3	74.3	71.1	74.3	74.3	75.6	58.4	72.9	88.4	58.4	72.9	88.4
7.	Imazethapyr 10% SL	1000	51.6	51.6	57.8	51.6	51.6	53.9	45.5	61.8	73.8	45.5	61.8	73.8
8.	Weed free check(hand weeding at 20 and 40 days after sowing)	-	95.3	95.3	93.3	95.3	95.3	95.5	94.3	96.4	99.0	94.3	96.4	99.0
9.	Weedy check (Untreated control)	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000	99.32	99.3	99.4	99.3	99.3	99.3	99.1	99.5	99.8	99.1	99.5	99.8

Table 7: Effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on per cent weed control efficiency (WCE) at various crop stage of soybean

Treatment		Dose ml/ha	*Eleucine indica* (Goose grass)			*Phalaris minor* (Canary grass)		
			15 DAS	30 DAS	60 DAS	15 DAS	30 DAS	60 DAS
1.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1125	58.0	84.7	84.7	NA	NA	NA
2.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1500	69.0	89.9	89.9	NA	NA	NA
3.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1875	75.0	90.8	90.8	NA	NA	NA
4.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	70.7	90.2	90.2	NA	NA	NA
5.	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	61.6	85.7	85.7	NA	NA	NA
6.	Quizalofop Ethyl 10% EC Market sample)	375	58.4	88.4	88.4	NA	NA	NA
7.	Imazethapyr 10% SL	1000	45.5	73.8	73.8	NA	NA	NA
8.	Weed free check(hand weeding at 20 and 40 days after sowing)	-	94.3	99.0	99.0	NA	NA	NA
9.	Weedy check (Untreated control)	-	0.0	0.0	0.0	NA	NA	NA
10.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000	99.1	99.8	99.8	NA	NA	NA

Table 8: Effect of Fomesafen 12 % + Quizalofop ethyl 3% w/w SC on grain yield of soybean

	Treatment	Dose ml/ha	Grain yield (q/ha)
1.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1125	16.733
2.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1500	18.100
3.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (BCSLLP sample)	1875	16.500
4.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC (Market sample)	1500	18.200
5.	Propaquizafop 2.5% + Imazethapyr 3.75% w/w ME	2000	15.533
6.	Quizalofop Ethyl 10% EC Market sample)	375	14.633
7.	Imazethapyr 10% SL	1000	15.733
8.	Weed free check(hand weeding at 20 and 40 days after sowing)	–	19.733
9.	Weedy check (Untreated control)	–	11.367
10.	Fomesafen 12 % + Quizalofop ethyl 3% w/w SC for phytotoxicity & Residue studies only	3000	
	CD 5%		1.104
	Result		Sig

REFERENCES

Kamble A B, Nagre BS and Dhonde M B (2017). Effect of crop geometry and weed management practices on weed dynamics and yield of soybean. In: Proceedings of Biennial Conference on "Doubling Farmers' Income by 2022: The Role of Weed Science", 1-3 March, 2017, Udaipur. *Indian Society of Weed Sci, Jabalpur, India* pp: 127.

Kewat M L, Pandey J, Yaduraju N T and Kulshreshtha G (2000). Economic and ecofriendly weed management in soybean. *Indian J Weed Sci* **32**(3&4): 135-139.

Kundu R, Brahmachari K, Bera PS, Kundu CK and Roychoudhury S (2011). Bioefficacy of imazethapyr on the pre dominant weeds in soybean. *J Crop and Weed* **7**(2): 173-178.

Panse, V G and Sukhatme P V (1985) Statistical Methods for Agricultural Workers. *Indian Council of Agricultural Research Publication*, 87-89.

Sharma R K and Shrivastava V K (2002). Weed control in soybean. *Indian J Agron* **47**(2): 269-272.

SOPA(2023). The Soybean Processors Association of India statistics URL: www.sopa.org

Wadafale AM Pagar PC, Yenprediwar MD and Benke PS (2011). Effect of some new post emergence herbicides on weed and plant growth parameters of soybean. *J Soils and Crops* **21**(2): 258-262.

Received on 28/9/2024 Accepted on 30/10/2024