Biological Forum – An International Journal **15(11): 130-135(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Evaluation of Quizalofop-ethyl and its Ready Mix Combinations for Weed Management in French Bean (*Phaseolus vulgaris* L.)

Ketan[1], Shabnam Thakur[2*], Sunil Kumar Gola[3], S.S. Rana[2], D.R. Chaudhary[1] and Priyanshi Kaul[1]
[1]Department of Vegetable Science and Floriculture,
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (Himachal Pradesh), India.
[2]Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (Himachal Pradesh), India.
[3]Department of Vegetable Science, CCS Haryana Agricultural University, Hisar (Haryana), India.

(Corresponding author: Shabnam Thakur[*])
(Received: 03 September 2023; Revised: 01 October 2023; Accepted: 17 October 2023; Published: 15 November 2023)
(Published by Research Trend)

ABSTRACT: French bean is quite sensitive to weed interference, particularly during the early phases of vegetative development. The critical period for crop-weed competition in Frenchbean ranged between 28-37 days after sowing (DAS) when the crop should be kept free from weeds to prevent the potential yield losses. Thus, for the effective control of weeds throughout the crop season, use of post-emergence herbicides or their combinations is necessary. Therefore, a field investigation was conducted at the Experimental Farm of the Department of Vegetable Science and Floriculture, CSK HPKV, Palampur during *Kharif*, 2022 to infer about the quizalofop-ethyl and its ready to use combinations for weed management in French bean (*Phaseolus vulgaris* L.). The experimental site's soil was acidic, silty clay loam, medium in organic carbon, low in available nitrogen, medium in accessible phosphorus, and potassium. Eleven treatment combinations comprising of sprays of herbicides coupled with and without hand weeding were evaluated in a Randomized Block Design with three replications during *Kharif*, 2022. The most common weed flora identified in the experimental field was comprised of *Digitaria sanguinalis* (37.2%), *Trifolium repens* (20.4%), *Cyperus rotundus* (14.4%), *Artimissia vulgaris* (12.0%) and *Alternanthera philoxeroides* (15.6%). Results of the study revealed that hand weeding (twice) and pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW effectively reduced the count of weed species. Based on the results obtained from the study, it was concluded that the treatments, hand weeding (twice) and pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW were the best options for obtaining higher pod yield and management of complex weed flora in French bean.

Keywords: Pretilachlor, Oxyfluorfen, Imazethapyr, Quizalofop-ethyl, French bean, Weed flora.

INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is commercially cultivated in hilly areas of Jammu and Kashmir, Himachal Pradesh, Uttarakhand and certain areas of Maharashtra (Tripathi *et al*., 1986; Sood *et al*., 2003), occupying an area of approximately 228.0 thousand hectares and producing 2257 thousand metric tons in the country. In Himachal Pradesh, it is mainly cultivated as a market crop in mid and high hill areas covering about 3.82 thousand hectares with a production of about 50.87 thousand metric tons. Cultivation of French bean has become more popular amongst growers on account of its off-seasonality, relative ease in cultivation and higher profit margins. The produce is generally sold in the internal markets bringing lucrative return to the growers. Weeds are a severe problem in this crop because of the frequent irrigation and high fertility which provide favourable conditions for their growth and development and consequently reduce the production by 20-60 per cent (Anonymous, 2009). Among the numerous weed control techniques, herbicide use is not only efficient but also cost effective. Physical weed management measures, such as hand weeding, on the other hand, are safe but time consuming (Chavan *et al*., 2020). Weeds can be controlled effectively by applying pre-emergence herbicides during the critical period of crop weed competition without causing phytotoxicity (Kumar *et al.,* 2010). The continued use of pre-emergence herbicides in crops, on the other hand, shifts the annual-perennial balance in favor of perennial weeds. The use of low-dose pre-emergence herbicides in conjunction with hand weeding 30-40 days after seeding is safe for the environment, socially acceptable, and economically viable (Kumar *et al*., 2011). However, shortage of labor during critical periods of crop-weed competition, as well as often unfavorable field circumstances, precludes hand weeding. In the literature, significant information on pre-emergence herbicides for weed control has been published from numerous sources, but information on post-emergence herbicides or their mixtures is limited. Many times, extension workers and farmers request information on

post-emergence herbicides or their mixtures, especially when they are unable to spray pre-emergence herbicides for one reason or another, such as a lack of labor for manual weeding. As a result, it is critical to identify appropriate herbicide (s) and their combinations to manage the diverse appropriate weed flora in French bean.

MATERIALS AND METHODS

The field investigation was conducted at Experimental Farm of the Department of Vegetable Science and Floriculture, CSK HPKV, Palampur [32°6´ North latitude and 76°3´ East longitude and 1290 m above mean sea level] during *kharif*, 2022. The place is located in Himachal Pradesh's mid-hill zone. This zone's soil is podzolic with a pH range of 5.0-6.0. The experimental field's soil was silty clay loam in texture, acidic in response, high in organic carbon (0.71%), low in available nitrogen (407 kg/ha), high in phosphorus (17.2 kg/ha), and low in potassium (162 kg/ha). Eleven treatment combinations namely, oxyfluorfen 150 g/ha (pre-emergence), pretilachlor 1000 g/ha (pre-emergence), imazethapyr 100 g/ha (pre-emergence), quizalofop- ethyl 100 g/ha (pre-emergence), oxyfluorfen 100 g/ha (pre-emergence) *fb* quizalofop-ethyl 70 g/ha (post-emergence), pretilachlor 700 g/ha (pre-emergence) *fb* quizalofop-ethyl 70 g/ha (post-emergence), imazethapyr 70 g/ha (pre-emergence) *fb* quizalofop-ethyl 70 g/ha (post-emergence), pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* quizalofop-ethyl 50 g/ha + chlorimuron 3 g/ha (post-emergence), pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW, 2 HWs (30 and 45 DAS) and weedy check were tested in a randomized block design with three replications. Herbicidal sprays were administered immediately after sowing (pre-emergence) and 30 days later (post-emergence) with a knapsack sprayer and a flat fan nozzle in 750 liters of water per hectare. Weed counts were taken for each species at 40, 60, and harvest. Growth, yield characteristics, and yield were all recorded at various growth and harvest dates. The data was statistically analyzed according to Panse and Sukhatme (1984), and the treatments were compared at a 5% level of significance to interpret the differences. The weed count data were evaluated after the original data was square root transformed, *i.e.* $\sqrt{(x + 0.5)}$ and the treatment effects were calculated.

RESULTS AND DISCUSSION

The most common weed flora identified in the experimental field was comprised of *Digitaria sanguinalis (*37.2%), *Trifolium repens* (20.4%), *Artimissia vulgaris* (12.0%), *Cyperus rotundus* (14.4%) and *Alternanthera philoxeroides (*15.6%). Similar type of weed flora under Palampur conditions during *Kharif season* in general and French bean crop in particular has also been reported earlier by Rana *et al*. (2008).

Effect on weeds. Hand weeding twice had lower count of *Digitaria sanguinalis.* Among different herbicidal weed control treatments, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW and pretilachlor 700 g/ha (pre-emergence) *fb* quizalofop-ethyl 70 g/ha (post-emergence), exhibited statistically similar results, both resulted in significantly lower count of *Digitaria sanguinalis* (Table 1).

Table 1: Effect of weed control treatments on weed count (No./m^2) at maximum population stage *i.e.* 80 DAS.

Treatment	Dose (g/ha)	*Digitaria sanguinalis*	*Trifoliumrepens*	*Artimissia vulgaris*	*Cyperusrotundus*	*Alternanthera philoxeroides*
Oxyfluorfen	150	9.3 (85.3)	5.9 (34.7)	6.4 (41.3)	6.7 (44.0)	6.4 (40.0)
Pretilachlor	1000	9.9 (97.3)	5.8 (33.3)	5.8 (33.3)	6.0 (36.0)	5.4 (29.3)
Imazethapyr	100	10.7 (114.7)	6.3 (38.7)	6.4 (41.3)	7.2 (52.0)	6.6 (42.7)
Quizalofop-ethyl	100	11.4 (129.3)	7.2 (52.0)	6.6 (42.7)	6.8 (46.7)	6.8 (45.3)
Oxyfluorfen *fb* quizalofop-ethyl	100 *fb* 70	10.8 (116.0)	8.5 (72.0)	7.2 (52.0)	6.8 (46.7)	7.6 (57.3)
Pretilachlor *fb* quizalofop-ethyl	700 *fb* 70	8.7 (76.0)	8.4 (69.3)	6.8 (45.3)	7.0 (48.0)	7.0 (49.3)
Imazethapyr *fb* quizalofop-ethyl	70 *fb* 70	10.6 (112.0)	8.6 (73.3)	6.5 (42.7)	7.2 (52.0)	6.9 (46.7)
Pretilachlor+ imazethapyr *fb* quizalofop-ethyl+ chlorimuron ethyl	500 + 50 *fb* 50 + 3	12.0 (142.7)	5.9 (34.7)	6.1 (37.3)	6.4 (41.3)	6.3 (38.7)
Pretilachlor + imazethapyr *fb* HW	500 + 50	8.5 (72.0)	5.7 (32.0)	5.4 (29.3)	5.7 (32.0)	5.1 (25.3)
Hand weeding (Twice)	-	7.2 (52.0)	4.8 (22.7)	5.3 (28.0)	4.8 (22.7)	4.1 (18.7)
Weedy Check	-	14.9 (221.3)	10.7 (113.3)	8.7 (74.7)	8.9 (80.0)	9.3 (86.7)
SE (m) ±		0.2	0.2	0.4	0.4	0.5
CD (P = 0.05)		0.6	0.6	1.1	1.3	1.5

Values in parentheses are the means of original values. Data transformed to $\sqrt{(x + 0.5)}$

These findings are consistent with the findings of Rana (2002) who obtained effective weed management with the spray of pre-emergence herbicides like pendimethalin and fluchlorlin in French bean. The experimental results obtained by Singh *et al*. (2015); Kavad *et al*. (2016) further supported the efficiency of imazethapyr + imazamox (RM) in the French bean.

Hand weeding conducted twice demonstrated significant superiority in reducing the population of *Trifoliumrepens*. Among various weed control treatments, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, and pretilachlor 1000 g/ha (pre-emergence), oxyfluorfen 150 g/ha (pre-emergence), pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by quizalofop-ethyl 50 g/ha + chlorimuron ethyl 3 g/ha (post-emergence), and imazethapyr 100 g/ha (pre-emergence) resulted in a significantly lower count of *Trifolium repens.* However, the treatment involving imazethapyr 70 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) was found to be the least effective against *Trifolium repens*. These results are consistent with the earlier findings of Kumar *et al.* (2014), who demonstrated the efficacy of pre-emergence herbicides like pendimethalin and fluchloralin in effectively controlling *Trifolium repens* in French bean cultivation.

Hand weeding performed twice exhibited a notably lower weed count of *Artemisia vulgaris* compared to other treatments. Among the various herbicidal weed control approaches, the combination of pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, pretilachlor 1000 g/ha (pre-emergence), pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by quizalofop-ethyl 50 g/ha + chlorimuron ethyl 3 g/ha (post-emergence), oxyfluorfen 150 g/ha (pre-emergence), imazethapyr 100 g/ha (pre-emergence), and imazethapyr 70 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) resulted in a significantly lower count of *Artemisia vulgaris* compared to other weed control treatments. Conversely, the treatment involving oxyflurofen 100 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) was found to be the least effective against *Artemisia vulgaris*. These findings align with Kumar *et al.* (2014), highlighting the effectiveness of specific pre-emergence herbicides in managing *Artemisia vulgaris* in French bean cultivation.

Hand weeding conducted twice demonstrated a significantly lower count of *Cyperus rotundus* compared to other treatments. Pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, pretilachlor 1000 g/ha (pre-emergence), pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by quizalofop-ethyl 50 g/ha + chlorimurion-ethyl 3 g/ha (post-emergence), oxyfluorfen 150 g/ha (pre-emergence), oxyfluorfen 100 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), quizalofop-ethyl 100 g/ha (post-emergence), and pretilachlor 700 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) resulted in a significantly lower population of *Cyperus rotundus* compared to other herbicidal weed control treatments. Conversely, the treatments involving imazethapyr 70 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) and imazethapyr 100 g/ha (pre-emergence) were found to be the least effective against *Cyperus rotundus* compared to other treatments. Similar results were also observed in experiments conducted by Kumar *et al.* (2014) and Singh *et al.* (2018), where the spray of pre-emergence herbicides like pendimethalin and fluchloralin was found to be effective in controlling *Cyperus rotundus* in French bean cultivation.

Hand weeding (twice) had significantly lower weed count of *Alternanthera philoxeroides* as compared to other treatments. All the weed control treatments differed significantly and were statistically superior to weedy check in lowering down the count of *Alternanthera philoxeroides* at all the stages of observation. These results are in accordance with the findings of Kavad *et al*. (2016), who observed similar weed flora which was effectively controlled with the spray of pre-emergence herbicides like pendimethalin. Among different herbicidal weed control treatments, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW behaving statistically similar with pretilachlor 1000 g/ha (pre-emergence), pretilachlor 500 g/ha + imazethapyr 50g/ha (pre-emergence) *fb* quizalofop-ethyl 50 g/ha + chlorimurion 3 g/ha (post-emergence), oxyfluorfen 150 g/ha (pre-emergence) and imazethapyr 100 g/ha (pre-emergence) resulted in significantly lower count of *Alternanthera philoxeroides* at all the stages of observation. The treatment, oxyfluorfen 100 g/ha (pre-emergence) *fb*quizalofop-ethyl 70 g/ha (post-emergence) was least effective against *Alternanthera philoxeroides* when compared with all other weed control treatments.

Due to the decrease in species-wise weed count, weed control treatments led to a significant reduction in the total weed count compared to the weedy check. The application of pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding and pretilachlor 1000 g/ha (pre-emergence), exhibiting statistical similarity, resulted in a significantly lower population of weeds. This effectiveness was attributed to the successful weed control achieved through the application of pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, which effectively reduced the species-wise weed population, ultimately resulting in the lowest weed count. Chaudhry *et al.* (2014) also reported that hand weeding twice significantly reduced the weed population and weed biomass. In general, pre- emergence application of herbicides was better than post-emergence application for effective weed control

Effect on crop. Various weed control treatments significantly influenced the emergence count, as indicated in (Table 2).

Table 2: Effect of weed control treatments on emergence count (No./m^2) of crop, no. of plants at final stage and plant height at initial and final stage.

Treatment	Dose (g/ha)	Emergence count (No./m^2)	No. of plants at final stage (No./m^2)	Plant height (cm)	
				Initial	Final
Oxyfluorfen	150	57.0	46.0	28.4	41.1
Pretilachlor	1000	95.0	75.7	38.7	46.2
Imazethapyr	100	73.0	54.7	40.2	45.7
Quizalofop-ethyl	100	66.0	45.7	38.8	44.0
Oxyfluorfen *fb* quizalofop-ethyl	100 *fb*70	65.0	55.0	34.5	41.3
Pretilachlor *fb* quizalofop-ethyl	700 *fb* 70	117.3	92.0	38.0	45.0
Imazethapyr *fb* quizalofop-ethyl	70 *fb* 70	86.3	71.3	40.0	46.0
Pretilachlor+ imazethapyr *fb* quizalofop-ethyl+ chlorimuron ethyl	500 + 50 *fb* 50 + 3	114.3	83.3	42.0	45.7
Pretilachlor + imazethapyr *fb* HW	500 + 50	116.0	94.3	39.3	47.7
Hand weeding (twice)	-	105.0	98.7	36.8	49.0
Weedy check	-	86.3	42.7	36.8	40.7
SE (m) ±		1.3	1.7	1.6	1.8
CD (P =0.05)		3.8	5.0	4.8	5.3

Highest emergence count was recorded in pretilachlor 700 g/ha (pre-emergence) *fb* quizalofop-ethyl 70 g/ha (post-emergerence) but this treatment was statistically at par with pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW and pretilachlor 500 g/ha + imazethapyr 50g/ha (pre-emergence) *fb* quizalofop-ethyl 50 g/ha + chlorimurion 3 g/ha (post-emergence).

Differences in weed control treatments significantly impacted the plant population at both the initial and final stages of growth, as reflected in (Table 2). Although the highest plant population (98.7/m^2) was observed in the hand weeding (twice) treatment, this outcome was statistically comparable to the treatments involving pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding and pretilachlor 700 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence). Conversely, the herbicidal treatments, quizalofop-ethyl 100 g/ha (post-emergence) and oxyfluorfen 150 g/ha (pre-emergence), recorded the lowest plant population.

Plant height exhibited significant variations among different weed control treatments. Hand weeding conducted twice resulted in significantly taller plants, and this effect was comparable to the herbicidal treatments, including pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, pretilachlor 1000 g/ha (pre-emergence), imazethapyr 70 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), imazethapyr 100 g/ha (pre-emergence), pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by quizalofop-ethyl 50 g/ha + chlorimuron ethyl 3 g/ha (post-emergence), pretilachlor 700 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), and quizalofop-ethyl 100 g/ha (post-emergence). Conversely, treatments incorporating oxyfluorfen 150 g/ha (pre-emergence) and oxyflurofen 100 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) recorded comparatively shorter plant heights. This observed effect could be attributed to the effective control of weeds up to 45 DAS, thereby enhancing crop growth during the initial stages of plant development. Similar findings were reported by Kavad *et al.* (2016), emphasizing significant differences in plant height with the application of various herbicides in their experimental studies.

Table 3: Effect of weed control treatments on pod yield and yield attributes of French bean.

Treatment	Dose (g/ha)	Pod length (cm)	Pod diameter (cm)	Pods/ plant	Pod weight (g)	Pod Yield/ plant (g)
Oxyfluorfen	150	11.7	0.7	18.4	3.5	64.40
Pretilachlor	1000	12.7	0.7	26.3	3.9	102.57
Imazethapyr	100	11.7	0.7	23.2	4.0	92.80
Quizalofop-ethyl	100	12.0	0.6	22.9	4.2	96.20
Oxyfluorfen *fb* quizalofop-ethyl	100 *fb* 70	11.0	0.6	21.6	4.0	86.40
Pretilachlor *fb* quizalofop-ethyl	700 *fb* 70	11.3	0.6	25.6	4.0	102.40
Imazethapyr *fb* quizalofop-ethyl	70 *fb* 70	12.3	0.7	25.3	4.0	101.20
Pretilachlor+ imazethapyr *fb* quizalofop-ethyl+ chlorimuron ethyl	500 + 50 *fb* 50 +3	11.7	0.7	28.0	3.7	103.6
Pretilachlor + imazethapyr *fb* HW	500 + 50	13.3	0.6	29.8	4.3	128.14
Hand weeding (twice)	-	14.0	0.7	30.9	4.7	145.23
Weedy check	-	8.7	0.6	16.2	2.4	38.88
SE(m) ±		0.6		1.2	0.2	9.0
CD (P = 0.05)		1.7	NS	3.6	0.6	26.4

The effects of treatments on pod length is significantly influenced by spray of different doses of both pre and post-emergence herbicides (Table 3). The treatment incorporating hand weeding performed twice resulted in longer pod length, and this effect was statistically comparable to different herbicidal treatments, including pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, pretilachlor 1000 g/ha (pre-emergence), imazethapyr 70 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), quizalofop-ethyl 100 g/ha (post-emergence), imazethapyr 100 g/ha (pre-emergence), and oxyflurofen 150 g/ha (pre-emergence). However, the treatment involving oxyfluorfen 100 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence) resulted in shorter pods, statistically comparable to pretilachlor 700 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence).

Hand weeding (twice) had more pods per plant but it was statistically comparable with herbicidal treatments namely, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* quizalofop-ethyl 50 g/ha + chlorimuron ethyl 3 g/ha (post-emergence) and pretilachlor 1000 g/ha (pre-emergence) which had more number of pods per plant. This might be due to reduction in weed flora observed in the treatments with sprays of both pre and post-emergence herbicides which resulted in healthy crop stand due to enhanced crop growth leading to the production of more number of pods per plant. The results of the present investigation corroborate with the findings of Prachand *et al*. (2015); Panotra and Kumar (2016) who obtained more number of pods per plant in the treatments supplemented with the sprays of both pre and post-emergence herbicides coupled with hand weeding.

Pod weight was significantly influenced by various weed control treatments. Among these treatments, all weed control treatments, including hand weeding conducted twice, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, quizalofop-ethyl 100 g/ha (post-emergence), imazethapyr 100 g/ha (pre-emergence), oxyflurofen 100 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), pretilachlor 700 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), imazethapyr 70 g/ha (pre-emergence) followed by quizalofop-ethyl 70 g/ha (post-emergence), pretilachlor 1000 g/ha (pre-emergence), and pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by quizalofop-ethyl 50 g/ha + chlorimuron ethyl 3 g/ha (post-emergence), except oxyflurofen 150 g/ha (pre-emergence), were statistically comparable. This can be attributed to the reduced competition from a diminished weed population during the pod formation stage, ultimately leading to increased pod weight in treatments with effective weed control. Similar findings have been reported by Ram *et al.* (2012); Rana *et al.* (2013); Singh *et al.* (2015) in experiments conducted on leguminous crops, specifically French bean and garden pea.

Pod yield per plant was significantly impacted by various weed control treatments. The treatment involving two hand weedings, although statistically comparable to herbicidal treatments such as pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, resulted in the significantly highest pod yield per plant compared to other weed control approaches. Among herbicidal treatments, pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by hand weeding, being comparable to pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) followed by quizalofop-ethyl 50 g/ha + chlorimuron ethyl 3 g/ha (post-emergence), achieved the highest pod yield. Both these treatments demonstrated effective weed management, creating favorable conditions for better plant establishment and ultimately leading to increased pod yield. These results align with the observations of Panotra and Kumar (2016); Patel *et al.* (2017), who noted a higher number of pods per plant and increased pod yield in French bean and other leguminous crops as a result of effective weed management.

CONCLUSIONS

The study's findings clearly show that the combined application of pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW and hand weeding (twice) appeared as one of the best options for complex weed flora management and obtaining higher pod yield of French bean.

FUTURE SCOPE

After thorough validation of 2-3 years in the farmer's field, this study could be useful to farmers for successful weed control by herbicide in French bean.

Acknowledgement. The authors are thankful to the other members of Department of Vegetable Science and Floriculture at CSKHPKV, Palampur for their help throughout the experimentation.

Conflict of Interest. None.

REFERENCES

Anonymous (2009). Pulses in India-An insight into the world's leading consumer of pulses. *Annual Report*, IIPR, Kanpur.

Chaudhry, S., Verma, V. K., Singh, V., Pyare, R. and Singh, A. K. (2014). Studies on efficiency of herbicides against weeds of blackgram *Vigna mungo* L. *Advanced Research Journal of Crop Improvement, 5*(1), 40-43.

Chavan, K. A., Suryavanshi, V. P., & Karanjikar, P. N. (2020). Analysis of weed control measures in Kharif french bean. *Journal of Pharmacognosy and Phytochemistry*, *9*(6S), 374-376.

Kavad, N. B., Patel, C. K., Patel, A. R. and Thumber, B. R. (2016). Integrated weed management in blackgram. *Indian Journal of Weed Science*, *48*(2), 222-224.

Kumar, A., Saxena, A. and Singh, P. K. (2014). Chemical and mechanical weed management for increased yield of French bean. *Indian Journal of Weed Science*, *46*(4), 350-352.

Kumar, S., Angiras, N. N., Rana, S. S. and Sharma, P. (2010). Crop- weed competition studies in okra *Abelmoschus esculentus* L. Moench under mid-hill condition of

Himachal Pradesh. *Himachal Journal of Agricultural Research, 36,* 13-19.

Kumar, S., Angiras, N. N., Sharma, P. and Rana, S. S. (2011). Integrated weed management in okra *Abelmoschus esculentus* L. Moench under mid-hill conditions of Himachal Pradesh. *Himachal Journal of Agricultural Research, 37,* 10-16.

Panotra, N. and Kumar, A. (2016). Weed management practices on winter French bean *Phaseolus vulgaris* L. under western Uttar Pradesh conditions. *International Journal of Applied Science, 4*(2), 275-283.

Panse, V. G. and Sukhatme, P. V. (1984). Statistical Methods for Agricultural Workers, *ICAR, New Delhi*, P, 359.

Patel, R. I., Piyush, K. S., Patel, P. H. and Patel, V. N. (2017). Effect of different crop management practices on growth and yield of field pea. *The Bioscan, 12*(1), 667-669.

Prachand, S., Kalhapure, A. and Kubde, K. J. (2015). Weed management in soybean with pre and post-emergence herbicides. *Indian Journal of Weed Science, 47*(2), 163-165.

Ram, B., Punia, S.S., Meena, D. S. and Tetarwal, J. P. (2012). Efficacy of post emergence herbicides on weed control and seed yield of rajmash *Phaseolus vulgaris* L. *Journal of Food Legumes, 25*(4), 306-309.

Rana, M.C., Nag, M., Rana, S.S. and Sharma, G.D. (2013). Influence of post-emergence herbicides on weeds and productivity of garden pea *Pisum sativum* L. under mid hill conditions of Himachal Pradesh. *Indian Journal of Agronomy, 58*(2), 226-230.

Rana, S. S. (2002). Evaluation of promising herbicide combinations for weed management in Rajmash *Phaseolus vulgaris* L. under dry temperate conditions of Himachal Pradesh. *Indian Journal of Weed Science, 34*(3 & 4), 227-230.

Rana, S. S., Sood, P., Pathania, P., Kumar, S., Chadha, S. and Chaudhary, D. R. (2008). Crop-weed competition in french bean *Phaseolus vulgaris* L. under dry temperature conditions of North-western Himalaya. *Himachal Journal of Agricultural Research, 34*(2), 10-14.

Singh, G., Kaur, H., Aggarwal, N. and Sharma, P. (2015). Effect of herbicides on weed growth and yield of green gram. *Indian Journal of Weed Science, 47*(1), 38-42.

Singh, S. M. I. T. A., Singh, R. P., Shukla, U. N., Singh, J. K., & Singh, O. N. (2018). Efficacy of herbicides and nutrient management on weed dynamics and yield of French bean (*Phaseolus vulgaris*). *Indian Journal of Agricultural Science. 88*, 1794-1800.

Sood, S., Awasthi, C. P. and Singh, N. (2003). Biochemical evaluation of promising Rajmash *Phaseolus vulgaris* L. genotypes in Himachal Pradesh. *Himachal Journal of Agricultural Research, 29*(1&2), 65-69.

Tripathi, D. P., Chandra, S. and Asthana, A. N. (1986). Technology for growing rajmash in plains. *Indian Farming, 36*(9), 12-15.

How to cite this article: Ketan, Shabnam Thakur, Sunil Kumar Gola, S.S. Rana, D.R. Chaudhary and Priyanshi Kaul (2023). Evaluation of Quizalofop-ethyl and its Ready Mix Combinations for Weed Management in French Bean (*Phaseolus vulgaris* L.). *Biological Forum – An International Journal, 15*(11): 130-135.