



Efficient weed management in groundnut (*Arachis hypogaea*) through appropriate herbicides

U K TRIPATHI¹ and R K SINGH^{2*}

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Vigyan Kendra Chhatarpur, Madhya Pradesh 471 201, India

Received: 4 November 2021; Accepted: 26 October 2022

Keywords: Economics, WCE, Weed dynamic, WI, Yield

Weeds are one among the foremost deterrent in sustainable crop production and cause substantial qualitative and quantitative losses ranging from 17–85% in rainy (*kharif*) season groundnut crop (Shwetha *et al.* 2016). Groundnut (*Arachis hypogaea* L.) crop is highly susceptible to weed infestation as their initial growth habit is slow and compete slowly with weed crop for available essential resources. In this situation, weeds show luxuriant growth by the use of all available essential resources like water, nutrients, radiation and space. Therefore, initial weed management is essential in this crop for better utilization of all available essential resource by more capture of sunlight through better spreading of crop canopy and more absorption of nutrients and water through better roots development under weed free area. Reduction in pod and grain yield of groundnut crop depends on the forms of magnitude of weed flora, their growth habit, and duration of infestation and competition for nutrients, air, water, radiation and space. The critical period of crop weed competition in groundnut was reported up to 40–60 DAS. Hence, for achieving higher pods yield/ha, timely and effective weed management during crop weed competition becomes essential. Hand weeding is effective method but it is incredibly tedious, time-taking and expensive in India (Prajapati *et al.* 2015). Delay in weeding, sometimes causes reduction in economic yield and quality of produce and also increases the incidence of diseases and pests. Application of recommended herbicides under such situation appears to be an appropriate option for wide spectrum weed control. The pre-emergence (PE) herbicides are used for controlling weeds during germination stages but this enables the emergence of weeds at later stages. Use of herbicides post-emergence (PoE) in standing crop like imazethapyr, quizalofop or chlorimuron (Singh *et al.* 2020) was recommended for managing weeds effectively

at seedling stages of growth of soybean crop. Since, limited work on application of PE and PoE herbicides for managing weeds in groundnut is meagre. Therefore, the current study was taken on to identify the suitable herbicides alone or together for weed management in groundnut.

The trial was conducted during 2017–18 to 2018–19 at the Instructional Farm of Krishi Vigyan Kendra, Chhatarpur, Madhya Pradesh. The experiment was layout in RBD with 7 treatments, viz. T₀, Weedy Check; T₁, Alachlor 50 EC @1.5 kg a.i./ha; T₂, Oxyfluorfen 23.5 EC @100 g a.i./ha; T₃, Quizalofop-ethyl 5 EC @50 g a.i./ha; T₄, Fenoxaprop-P-ethyl 9.3 EC @50 g a.i./ha; T₅, Imazethapyr 10 SL @100 g a.i./ha + Fenoxaprop-P-ethyl 9.3 EC @37.5 g a.i./ha; T₆, Imazethapyr 10 SL @100 g a.i./ha + Quizalofop-ethyl 5 EC @37.5 g a.i./ha. The pre-emergence (just after sowing) and post-emergence (20 days after sowing) herbicides were used by sprayer fitted with a flat fan nozzle for similar distribution of herbicides at the farm. The sowing was done in the 2nd fortnight of July during 2017–18 to 2018–19. Weed observations were recorded with the help of quadrat at 60 DAS. Square root transformation as $\sqrt{x+0.5}$ was applied on weeds density for uniformity in their distribution. The weed FWm and DWm was recorded from different plots at 60 DAS (Table 1). Data on weed control efficiency (WCE), weed control index (WCI) and weed index (WI) was calculated by using the formulae as:

$$WCE (\%) = \frac{(XP_c - YP_t)}{XP_c} \times 100$$

Where, XP_c, weed density/m² in control plot; YP_t, weed density/m² in treated plot.

$$WCI (\%) = \frac{(DW_{m.c} - DW_{m.t})}{DW_{m.c}} \times 100$$

Where, DW_{m.c}, dry weed mass/m² in control plot; DW_{m.t}, Dry weed mass/m² in treated plot.

$$\text{Weed index } (\%) = \frac{(Y_t - Y_c)}{Y_c} \times 100$$

¹Krishi Vigyan Kendra, Satna, Madhya Pradesh; ²Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Vigyan Kendra, Chhatarpur, Madhya Pradesh. *Corresponding author email: rajiv_kvkv@rediffmail.com

Table 1 Effect of herbicides and its compatible mixture on weed spectrum and their control efficiency

Treatment	Nodule number/plant	Nodule diameter (mm)/nodule	Nodule dry weight(mg)/ plant	Weed density (no./m ²) at 60 DAS	FWm (g/m ²) at 60 DAS	DWm (g/m ²) at 60 DAS	WCE (%)	WCI (%)	WI (%)
T ₁	14.5	3.6	46.4	78.5 (9.4)	119.3	35.8			
T ₂	15.4	3.8	49.3	52.5 (8.2)	79.8	23.9	33.12	33.24	6.86
T ₃	16.5	3.8	52.8	50.5 (7.6)	76.8	23.0	35.66	35.7	17.39
T ₄	22.5	4.0	78.5	30.5 (6.5)	46.4	13.9	61.15	61.17	23.38
T ₅	22.2	4.1	77.7	30.0 (5.9)	45.6	13.8	61.78	61.73	29.1
T ₆	25.0	4.6	87.6	7.5 (3.7)	11.4	3.4	90.44	90.5	37.5
T ₇	25.5	5.1	89.3	5.0 (3.2)	7.6	2.3	93.63	93.57	41.35
CD (P=0.05)	1.25	0.41	2.4	1.33	3.7	0.48			

FWm, Fresh weed mass; DWm, Dry weed mass. Treatment details and WCE, WCI and WI details given in methodology.

Where, Yt, seed yield in weed free plot; Yc, seed yield in control plot. The statistical analysis was completed as per the methodology suggested by Panse and Sukhatme (1967).

Nodulation: Significantly higher nodules number, their diameter and weight (fresh/dry) was observed under the use of Imazethapyr 100 g a.i./ha + Quizalofop-ethyl @37.5 g a.i./ha followed by (fb) use of Imazethapyr @100 g a.i./ha + Fenoxaprop @37.5 g a.i./ha as compared to control plot. Maximum nodulation and their diameter was found by the enhanced utilization of available resource like space, water, nutrients and light under the timely check growth of weeds by the application of both herbicide. These herbicide act on site specific in meristematic tissues and suppress the newly developing leaves shortly after the application on leaf surface showing appearance of yellowing and necrotic symptoms within 6 days on weeds (Ramesh 2016). Therefore, crop plant showed improvement in the uptake of nutrients and light which ultimately improved their photosynthesis and supply of maximum carbohydrate to nodules for activation of nitrogen activity, improving their nodulation properties. Similar opinion was also put forward by Webster *et al.* (2020), Poornima *et al.* (2018) and Verma *et al.* (2020).

Weeds dynamics: Lower total weed density (5.0/m²), total weed fresh weight (7.6 g/m²) and dry weight (2.3 g/m²) was observed under the use of Imazethapyr 100 g a.i./ha + Quizalofop-ethyl @37.5 g a.i./ha followed by (fb) use of Imazethapyr @100 g a.i./ha + Fenoxaprop @37.5 g a.i./ha as compared to control plot. In investigation, weed growth was significantly suppressed and gave higher WCE (93.6%), WCI (93.57%), and WI (41.35%) which might have caused very less competition for light, space, air, minerals and water. While, weed control plot recorded significantly

higher weed density and total weed biomass (78.5 weeds and 119.3 g/m²) and reduced the pod yield by 46.5% over the use of Imazethapyr @100 g a.i./ha + Quizalofop @37.5 g a.i./ha. Imazethapyr was absorbed through foliage and root with fast movement through xylem and phloem through transpiration stream to actively growing meristematic zone through diffusion process that checked the effect of acetohydroxy acid synthase and the synthesis of branched-chain amino acids in legumes (Prajapati *et al.* 2015). Quizalofop accumulated in meristematic region within 24 h and inhibited the growth of weeds by inhabitation of the activity of acetyl-CoA carboxylase, an enzyme which is important for protein synthesis in meristematic tissue and leads to disruption of DNA synthesis and cell growth (Ramesh 2016). This resulted in poor growth of weeds and suppressed the newly developing leaves within 48 h after the application herbicide and complete damage of weeds within 6 days after the application of herbicide. Similar results were reported by Singh *et al.* (2017, 2020).

Yield and economics: Enhanced yield and yield attributes, net income and B:C ratio was obtained under the application of appropriate herbicides Imazethapyr @100 g a.i./ha + Quizalofop @37.5 g a.i./ha fb application of Imazethapyr @100 g a.i./ha + Fenoxaprop @37.5 g a.i./ha against control plot. The analyzed data on yield attributes like number of pods/plant, number of kernels/pod, test weight, yield q/ha of groundnut and economics like net return ₹/ha and benefit:cost ratio was found significantly higher (21.5, 2.6, 830.9 g, 16.2 q/ha, ₹44655/ha and 2.1) respectively under the application of Imazethapyr @100 g a.i./ha + Quizalofop @37.5 g a.i./ha fb Imazethapyr @100 g a.i./ha + Fenoxaprop @37.5 g a.i./ha (20.5, 2.4, 800.0 g, 15.2 q/ha, ₹39380 and 2.0) against control plot (Table 2).

Table 2 Effect of herbicide on growth, yield attributes and economics of groundnut

Treatment	Number of pods/plant	Number of kernels/pod	Test weight (g)	Yield (q/ha)	Economics of groundnut cultivation			
					COC (₹/ha)	GR (₹/ha)	NR (₹/ha)	B:C ratio (₹/ha)
T ₁	11.5	1.8	720.5	9.5	37700	50112.5	12412.5	1.3
T ₂	14.5	2.	750.6	10.2	38500	53805	15305	1.4
T ₃	14.8	2.1	750.8	11.5	38500	60662.5	22162.5	1.6
T ₄	16.6	2.2	776.5	12.4	39200	65410	26210	1.7
T ₅	16.5	2.2	780.6	13.4	39200	70685	31485	1.8
T ₆	20.5	2.4	800.8	15.2	40800	80180	39380	2.0
T ₇	21.5	2.6	830.9	16.2	40800	85455	44655	2.1
CD (P=0.05)	0.65	0.39	4.65	0.55	-	-	-	-

*Treatments details given in methodology. COC, Cost of cultivation; GR, Gross return; NR, Net return; B:C ratio, Benefit cost ratio.

The maximum pod yield with herbicidal treatment might be due to control of all weeds spectrum effectively as evident from the data on reducing weed density, weed dry weight and increasing WCI, as Imazethapyr and Quizalofop is systematic selective post-emergence herbicide. Imazethapyr is absorbed by foliage and root but quizalofop is absorbed by foliage to root system. While, both combination translocate through xylem and phloem and accumulate in meristematic region within 24 h and stop the growth of weeds by acetolactate synthesis (ALC) which is important for protein synthesis in meristematic tissues, leading to disruption of DNA synthesis and cell growth. Therefore, both combination of herbicide were quickly absorbed by both side foliage and root and translocated through xylem and phloem. They act in site specific meristematic tissues and therefore, cell division checks the new growth of leaf within 48 h after the application of herbicide and complete damage of weeds occurs within 6 days after the application of this combination (Ramesh 2016, Kakade *et al.* 2020). Therefore, the competition between groundnut and weeds for minerals, water, solar radiation and space was less under the above treatments, which enhanced greater capture of sun light, more synthesis of carbohydrates, and better partitioning of photosynthates towards pod formation. Similar results were reported by Shwetha *et al.* (2016) and Poornima *et al.* (2018).

Based on the experimentation, it was observed that through the application of Imazethapyr + Quizalofop or application of Imazethapyr + Quizalofop at 20 DAS was effective in controlling both grassy and broad-leaved weeds and produced the maximum yield with higher monetary return. Combination of herbicide at 20 DAS proved more easily usable and economically feasible in weed management practices in groundnut. As, manual weeding is not possible in erratic climatic conditions of rainy season under scarcity of labour and their high wages. In this situation, combination of herbicide molecules improves the quality of produce, yield and benefit:cost ratio. Both herbicides under various parameters ensure fast function and long time of working

on weed leaf due to their better performance and safe use for future crops.

SUMMARY

A field experiment was conducted during 2017–18 and 2018–19 in *kharif* season at Instructional Farm of Krishi Vigyan Kendra, Chhatarpur to study the suitable herbicides for effective management of weed flora of groundnut crop. Randomized block design was used with 4 replications consisting of 7 treatments as detailed in methodology. The results showed that combination of two compatible herbicide molecules like Imazethapyr 100 g a.i./ha + Quizalofop @37.5 g a.i./ha were quite effective against dominated mixed weed flora in groundnut, resulting in higher WCE, WCI, yield and economic net return (93.63%, 93.57%, 16.2 q/ha and ₹44655/ha) *fb* use of Imazethapyr @100 g a.i./ha + Fenoxaprop @37.5 g a.i./ha (90.44%, 90.5% 15.2 q/ha and ₹39380/ha respectively) as compared to control plot. Therefore, above herbicides will be better alternative for suppressing weed flora in the groundnut crop than the sole herbicide.

REFERENCES

- Kakade S U, Deshmukh J P, Solanke S and Thakare S. 2020. Efficacy of post-emergence of herbicide in groundnut. *Legume research*. DOI 10:18805/ LR-4404.
- Panse V G and Sukhatme P V. 1967. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi, India.
- Poornima S, Laxmi S Y, Prakash R T and Srinivas A. 2018. Weed management through early post emergence herbicides to improve productivity and nutrient uptake in greengram (*Vigna radiata* L.). *Indian Journal of Weed Science* 50(1): 81–84.
- Prajapati B, Singh T C, Giri P and Kewalanand. 2015. Efficacy of herbicide for weed management in Berseem. *The Bioscan* 10(1): 347–50.
- Ramesh T. 2016. Bio-efficacy of Quizalofop ethyl and Imazethapyr in blackgram. *Indian Journal of Weed Science* 48(3): 339–40.
- Shwetha B N, Umesh M R and Agna M B. 2016. Post-emergence herbicides for weed management in groundnut. *Indian Journal of Weed Science* 48(3): 294–96

- Singh S P, Yadav R S, Kumawat A, Bairwa R C and Reager M L. 2017. Groundnut productivity and profitability as influenced by weed control measures. *Indian Journal of Weed Science* **49**(4): 360–63.
- Singh R K, Uttam K T and Singh S R K. 2020. Performance of herbicides on effective weed management in soybean (*Glycine max*) crop. *Indian Journal of Agricultural Sciences* **90**(10): 1883–87.
- Verma L and Kuswaha H S. 2020. Evaluation of different herbicide against weeds in moongbean (*Vigna radiata L*). *Legume Research* **43**(6): 866–71.
- Webster E P, Telo G M, Rustom S Y J, Mckning B M and Blouin D C. 2020. Quizalofop p ethyl application in water seeded Coenzyme a Carboxylase-inhibiting herbicide resistant rice with different flood system. *Weed technology* **34**(2): 188–92.