



Effect of herbicidal weed management on growth, yield attributes and productivity of *Lathyrus* (*Lathyrus sativus* L.) for Chhattisgarh

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Abstract

The present research entitled "Effect of herbicidal weed management on growth, yield attributes and productivity of *Lathyrus* (*Lathyrus sativus* L.) for Chhattisgarh" was conducted during *Rabi* season of 2020-21 at the Instructional Farm, College of Agriculture, Raipur (CG). The soil of experimental site was sandy loam, poor in available nitrogen, medium in available phosphorus and rich in potassium contents with neutral pH. The experiment was laid out in Randomized Block Design with three replications. The treatments consisted of fifteen weed management practices *viz.*, T₁: Oxadiargyl @ 80 g/ha 0-3 DAS, T₂: Metribuzin @ 350 g/ha 0-3 DAS, T₃: Topramezone @ 19.35 g/ha 2-3 Leaf stage of weed, T₄: Topramezone @ 25.8 g/ha 2-3 Leaf stage of weed, T₅: Topramezone @ 32.25 g/ha 2-3 Leaf stage of weed, T₆: Topramezone (directed application) @ 25.8 g/ha 5-6 Leaf stage of weed, T₇: Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % (directed application) @ 250 g/ha 5-6 Leaf stage of weed, T₈: Metribuzin @ 350g/ha *fb* Topramezone @ 25.8 g/ha at 0-3 DAS & 2-3 Leaf stage of weed, T₉: Metribuzin @ 350g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed, T₁₀: Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % @ 250 g/ha 2-3 Leaf stage of weed, T₁₁: Sodium acifluorfen 16.5 % + clodinafop proparzyl 18 % (directed application) @ 187.5g/ha 2-3 leaf stage of weed T₁₂: Mertibuzin (directed application) @ 350 g/ha 2-3 leaf stage of weed, T₁₃: Metsulfuron (directed application) @ 4 g/ha 2-3 leaf stage of weed, T₁₄: Hand weeding twice 20 & 40 DAS and T₁₅: Unweeded control. The *Lathyrus* variety Prateek was sown on November 15, 2020 and harvested on March 8, 2021.

The experimental finding showed that the growth characteristics *viz.* plant population, plant height, number of branches/plant, dry weight accumulation (g/plant), number of nodules/plant, dry weight nodules/plant and crop growth rate and yield attributes *viz.*, number of seeds/plant, number of seeds/pod, seed yield, Stover yield, 100 seed weight and harvest index were found significantly superior in Hand weeding twice 20 & 40 DAS (T₁₄), over other weed management practices but was at par with treatment T₉: Metribuzin @ 350g/ha *fb* Metribuzin @ 350g/ha at 0-3 DAS & 5-6 Leaf stage of weed.

The lower values of above characters have been observed in the unweeded control (T₁₅) followed by Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % @ 250 g/ha 2-3 Leaf stage of weed (T₁₀). Predominant weed species *Medicago denticulate* L., *Cichorium intybus* L., *Chenopodium album* L., *Melilotus indica* L., *Alternanthera sessilis* L., *Echinochloa colona* L. and *Physallis minima* L, intensified in the experimental field. Hand weeding twice 20 & 40 DAS (T₁₄) followed by Topramezone @ 32.25 g/ha 2-3 Leaf stage of weed (T₅) observed in effectively reducing weed density, weed dry matter accumulation, lowest weed growth rate and thus providing maximum weed control efficiency and weed control index. While, the weed index was higher at Unweeded control (T₁₅).

In term of economic returns, the gross returns and net return was maximum under Hand weeding twice 20 & 40 DAS (T₁₄) followed Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (T₉), whereas, net return and B: C ratio was maximum under Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (T₉). This might be because of higher cost of cultivation due to continuous frequent weeding in Hand weeding twice 20 & 40 DAS plot (T₁₄).

Keywords: Weed management, attributes and productivity, *Lathyrus*

Introduction

Pulses are produced on 12-15 per cent of global arable land and their contribution to total human dietary protein nitrogen requirement is 30 % (Graham and Vance, 2003) [7]. The global legume/pulse production, area and yield during 2013 was 73 million tons (MT), 80.8 million ha (m ha) and 904 kg ha⁻¹, respectively (FAOSTAT, 2015) [6].

Though India being the largest producer (around 25.08 % of global production and 34.88 % of the world area), consumer (27 %) and importer (around 14 %) of pulses, the yield of pulses in India is at 789 kg ha⁻¹ which is quite low compared to average requirement of 1 t ha⁻¹ to make pulses production internationally competitive (Purushottam and Singh, 2015). In 2012-13 the total area, production and average productivity of all pulse crops was 23.3 m ha, 18.1 mt and 789 kg ha⁻¹, respectively (Datta and Singh, 2015).

During twelfth plan (2012-2016) the total area and production of Khesari were recorded at 5.11 lakh hectares and 4.07 lakh tons respectively. Chhattisgarh ranked the first position both in area and production (66.68 % and 60.54 %), followed by Bihar (13.10 % and 16.95 %). Madhya Pradesh ranked third in area (8.41 %), where's in production W.B. (12.19 %), respectively.

Lathyrus sativus (grass pea) is a high-yielding, drought-resistant legume consumed as a food in Northern India. Its development into an important food legume. However, has been hindered by the presence of the neurotoxin (beta-ODAP) in seeds which cause irreversible paralysis. Recently, some low-toxin lines have been developed that may prove safe for both animal and human foods (Duke, 1981).

The identification of high yielding and low ODAP lines, production is expected to increase in the future" (Smart *et al.*, 1994). The major grass pea growing states in India are Madhya

Pradesh, Maharashtra, Bihar, Orissa, West Bengal and Eastern Uttar Pradesh.

Chhatisgarh (Raipur, Durg, Rajnandgaon, Kabirdham, Bilaspur, Dhamtari, Raigarh, Mahasamund, Janjgir-Champa and Jashpur) and its adjoining areas of Vidarbha region of Maharashtra and MP are the major areas of its cultivation and consumption. In Chhatisgarh, its major cultivation is mainly under "Utera" system, where the seeds of grass pea are broadcasted on the standing water in the paddy field about 10-15 days before harvest.

Generally weeds are controlled by cultural or mechanical or chemical or biological methods either alone or in combination of more than one method. Weed management through manual weeding and hoeing, though effective in reducing the weed competition, are not free from several limitations such as unavailability of adequate laborers during weeding peaks and difficulty in the use of mechanical weeding in heavy soils due to incessant rains are the major constraints in effective weed control in Lathyrus. Moreover, hand weeding is tedious and time consuming and many a times damages surface feeding roots of the crop due to mechanical hand weeding. Inter-culture by hoe is another common practice locally called as *Dora* and is effective in inter row spaces and exerts severe stress on crop. Therefore use of pre-emergence and pre plant incorporation herbicides have a very short persistence in soil and weed flora may appear again after a time span and compete with the crops at later stages. Whereas post-emergence herbicide kill weeds and keep the hardy uncontrolled weeds under control by arresting their growth through various kinds of deformities in foliage and growing points. Under such situations the chemical weed control seems to be the best option to overcome the weed competition.

Materials and Methods

The experiment "Effect of herbicidal weed management on growth, yield attributes and productivity of Lathyrus (*Lathyrus sativus* L.) for Chhattisgarh" was conducted at Research cum Instructional Farm of IGKV, during Rabi season of 2020-21. The climate of the region is sub-humid to semi-arid. The soil of the experimental field was verticals with low, medium and high in N, P and K, respectively and neutral in reaction. The test variety was Prateek. The experiment was laid out in Randomized Block Design having three replications and fifteen treatments viz, T₁: Oxadiargyl @ 80 g/ha 0-3 DAS, T₂: Metribuzin @ 350 g/ha 0-3 DAS, T₃: Topramezone @ 19.35 g/ha 2-3 Leaf stage of weed, T₄: Topramezone @ 25.8 g/ha 2-3 Leaf stage of weed, T₅: Topramezone @ 32.25 g/ha 2-3 Leaf stage of weed, T₆: Topramezone (directed application) @ 25.8 g/ha 5-6 Leaf stage of weed, T₇: Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % (directed application) @ 250 g/ha 5-6 Leaf stage of weed, T₈: Metribuzin @ 350 g/ha *fb* Topramezone @ 25.8 g/ha at 0-3 DAS & 2-3 Leaf stage of weed, T₉: Metribuzin @ 350g/ha *fb* Metribuzin @ 350g/ha at 0-3 DAS & 5-6 Leaf stage of weed, T₁₀: Fluzifop-p-butyl 13.4% + Fomesafen 11.1 % @ 250 g/ha 2-3 Leaf stage of weed, T₁₁: Sodium acifluorfen 16.5 % + clodinafop propargyl 8 % (directed application) @ 187.5 g/ha 2-3 leaf stage of weed T₁₂: Mertibuzin (directed application) @ 350 g/ha 2-3 leaf stage of weed, T₁₃: Metsulfuron (directed application) @ 4 g/ha 2-3 leaf stage of weed, T₁₄: Hand weeding twice 20 & 40 DAS and T₁₅ : Unwedded control. Lathyrus variety Prateek was sown on 15th October, 2020 and harvested on 10th March, 2021. During crop growth period various yield attributing characters like pods plant⁻¹, seed pod⁻¹, seed index, seed yield and Stover yield were taken as per schedule and requirement of investigation.

Results and Discussion

Number of pods plant⁻¹

Number of pod /plant had observed significantly higher in treatment T₁₄: Hand weeding twice 20 & 40 DAS (12.91), over other weed management practices, however it was found at par with T₉: Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed, while treatment T₁₅: Unwedded control had found significantly lowest number of pod/plant (7.80).

This might be due to effective control of weeds in T₁₄ and T₉ which provided a competition free environment for crop growth, resulted increased number of pod/plant. This results was conformity to Singh *et al*, (2017) [15] and Kalhapure *et al.*, (2013) [10].

Number of seeds pod⁻¹

Higher number of seeds/pod had recorded in treatment T₁₄: Hand weeding twice 20 & 40 DAS (3.80), over other treatments followed by T₉: Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (3.77). On the other hand non-significantly lowest number of seeds/pod was found in T₁₅: Unwedded control (2.77).

Due to the proper control of weeds resulted better growth of crop and translocation of photosynthates in T₁₄ and T₉.

Seed weight (g)

Higher number of seeds/pod had recorded in treatment T₁₄: Hand weeding twice 20 & 40 DAS (8.43 g), over other treatments followed by T₉: Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (8.39 g). On the other hand non-significantly lowest number of seeds/pod was found in T₁₅: Unwedded control (6.40 g).

It may be because of minimum competition of weeds with crop resulted in bold seeds in treatment T₁₄ and T₉ resulted higher 100 seed weight.

Seed yield (kg ha⁻¹)

The data revealed that the treatment T₁₄: Hand weeding twice 20 & 40 DAS (1036.67 kg/ha) recorded significantly higher pod yield, over other weed management treatments, however it was statistically at par with the treatment T₉: Metribuzin @ 350g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (950.92 kg/ha). Significantly lowest seed yield was observed under treatment T₁₅: Unwedded control (348 kg/ha).

Higher pod yield in aforesaid treatments could be due to higher values of yield contributing characters viz. number of pods/plant, number of seeds/pod, seed weight resulted in proper utilizations of resources like nutrient, moisture, light and space by Lathyrus crop in low weed competition ultimately. The findings are in accordance with those recorded by Sahoo *et al*, (2017) [12], Singh *et al*, (2017) [15], Poonia *et al*, (2016) [11], Shwetha *et al*, (2016) [14], Sharma *et al*, (2015) [13], Babu *et al*, (2014) [1], Kalhapure *et al*, (2013) [10] and Bhale *et al*, (2011).

Stover yield (kg ha⁻¹)

The significantly higher stover yield was obtained under treatment T₁₄: Hand weeding twice 20 & 40 DAS (1904 kg/ha), over other treatments but was at par with T₉: Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (1881 kg/ha). On the other hand significantly lowest haulm yield was recorded with T₁₅: Unwedded control (1313 kg/ha).

The higher Stover yield found in treatment T₁₄ and T₉ might be because of lesser weed competition during growth and development period resulted better growth parameters thus

higher Stover yield. On the contrary, due to the increased competition of weeds in control plot an inverse trend was noticed and therefore the lowest yield was observed. Similar finding reported by Choudhari *et al.*, (2017), Singh *et al.*, (2017)^[15], Poonia *et al.*, (2016)^[11], Shwetha *et al.*, (2016)^[14], Sharma *et al.*, (2015)^[13], Jadhav *et al.*, (2015)^[8] and Babu *et al.*, (2014)^[1].

Harvest index (%)

The data showed that all weed management practices produced significantly higher harvest index in comparison to control. The highest harvest index was registered in T₁₄: Hand weeding twice 20 & 40 DAS (35.25 %) followed by among the chemical weed management practices, while treatment T₉: Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed was recorded higher harvest index (33.57 %). On the other hand significantly lowest harvest index was found by T₁₅: Unwedded control (20.97 %). Maximum harvest index under weed management practices might be due to proper translocation of photosynthetic at reproductive stage from

source to sink thus increase the seed production ratio in total produce. This result was conformity of Sahoo *et al.*, (2017)^[12].

Economics

Economics of field pea production in terms of gross return, net return and benefit: cost ratio was calculated for different treatments. The data reveals that highest gross return (₹ 37320 ha⁻¹) were reported under T₁₄: Hand weeding twice at 20 & 40 DAS. Whereas, maximum net realization (₹ 12263 ha⁻¹) and benefit: cost ratio (1.56) were recorded under T₉: Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed. A higher gross return in Metribuzin @ 350 g/ha *fb* Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed (T₉) is due to more seed yield than other treatment. The lowest gross realization (₹ 12550rs ha⁻¹), net realization (₹ - 6268 ha⁻¹) and B: C ratio (0.67) were recorded under T₁₅: Unweeded control. Similar results were reported by Chandolia *et al.*, (2010)^[3] and Kalaichelvi *et al.*, (2015)^[9]. That increase in seed rate resulted in higher yield and resulted in higher net returns.

Table 1: Yield attributing characters of Lathyrus as influenced by different weed management practices

	Treatments	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	100 Seed Weight (g)
T ₁	Oxadiargyl @ 80 g/ha at 0-3 DAS	11.20	3.48	8.06
T ₂	Metribuzin @ 350 g/ha at 0-3 DAS	10.51	3.24	7.68
T ₃	Topramezone @ 19.35 g/ha at 2-3 Leaf stage of weed	10.21	3.13	7.57
T ₄	Topramezone @ 25.8 g/ha at 2-3 Leaf stage of weed	10.04	3.03	7.43
T ₅	Topramezone @ 32.25 g/ha at 2-3 Leaf stage of weed	9.76	2.93	7.37
T ₆	Topramezone (directed application) @ 25.8 g/ha at 5-6 Leaf stage of weed	11.68	3.75	8.34
T ₇	Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % (directed application) @ 250 g/ha at 5-6 Leaf stage of weed	10.33	3.20	7.62
T ₈	Metribuzin @ 350 g/ha <i>fb</i> Topramezone @ 25.8 g/ha at 0-3 DAS & 2-3 Leaf stage of weed	11.55	3.63	8.21
T ₉	Metribuzin @ 350 g/ha <i>fb</i> Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed	12.33	3.77	8.39
T ₁₀	Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % @ 250 g/ha at 2-3 Leaf stage of weed	8.50	2.81	6.52
T ₁₁	Sodium acifluorfen 16.5 % + clodinafop proparzyl 8 % (directed application) @ 187.5 g/ha at 2-3 leaf stage of weed	10.89	3.31	7.88
T ₁₂	Mertibuzin (directed application) @ 350 g/ha at 2-3 leaf stage of weed	11.07	3.43	7.92
T ₁₃	Metsulfuron (directed application) @ 4 g/ha at 2-3 leaf stage of weed	11.26	3.52	8.19
T ₁₄	Hand weeding twice at 20 & 40 DAS	12.91	3.80	8.43
T ₁₅	Unwedded control	7.80	2.77	6.40
	S.E.M±	0.57	0.24	8.06
	CD (at 5% level)	1.65	NS	NS

Table 2: Seed yield, Stover yield and harvest index of Lathyrus as influenced by different weed management practices

S. No	Treatments	Seed yield (kg/ha)	Stover yield (Kg/ha)	Harvest index (%)
T ₁	Oxadiargyl @ 80 g/ha at 0-3 DAS	841.17	1786.83	32.01
T ₂	Metribuzin @ 350 g/ha at 0-3 DAS	768.00	1768.33	30.28
T ₃	Topramezone @ 19.35 g/ha at 2-3 Leaf stage of weed	758.33	1697.00	30.89
T ₄	Topramezone @ 25.8 g/ha at 2-3 Leaf stage of weed	714.37	1665.96	30.01
T ₅	Topramezone @ 32.25 g/ha at 2-3 Leaf stage of weed	663.00	1623.38	29.00
T ₆	Topramezone (directed application) @ 25.8 g/ha at 5-6 Leaf stage of weed	924.33	1851.66	33.30
T ₇	Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % (directed application) @ 250 g/ha at 5-6 Leaf stage of weed	760.17	1692.17	31.00
T ₈	Metribuzin @ 350g/ha <i>fb</i> Topramezone @ 25.8 g/ha at 0-3 DAS & 2-3 Leaf stage of weed	912.33	1843.92	33.10
T ₉	Metribuzin @ 350 g/ha <i>fb</i> Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed	950.92	1881.58	33.57
T ₁₀	Fluzifop-p-butyl 13.4 % + Fomesafen 11.1 % @ 250 g/ha at 2-3 Leaf stage of weed	593.75	1603.08	27.03
T ₁₁	Sodium acifluorfen 16.5 % + clodinafop proparzyl 8 % (directed application) @ 187.5 g/ha at 2-3 leaf stage of weed	781.21	1731.21	31.09
T ₁₂	Mertibuzin (directed application) @ 350 g/ha at 2-3 leaf stage of weed	819.41	1765.75	31.70
T ₁₃	Metsulfuron (directed application) @ 4 g/ha at 2-3 leaf stage of weed	868.25	1814.92	32.36
T ₁₄	Hand weeding twice at 20 & 40 DAS	1036.67	1904.21	35.25
T ₁₅	Unwedded control	348.62	1313.96	20.97
	S.E.M±	50.65	104.87	-
	CD (at 5 % level)	146.71	303.80	-

Conclusion

The results of the experiment further concluded that Hand weeding twice 20 & 40 DAS treatment obtained higher value for yield contributing characters viz. number of number of pod/plant, number of seeds/pod and 100 seed weight and harvest index followed by Metribuzin @ 350 g/ha fb Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed.

Hand weeding twice 20 & 40 DAS DAS was found economically beneficial as compare to other treatments. The highest gross return of (Rs. 37320 kg /ha) was found in Hand weeding twice 20 & 40 DAS treatment, however net return (Rs 12263 kg/ha) and B: C ratio (1.56) was higher in Metribuzin @ 350 g/ha fb Metribuzin @ 350 g/ha at 0-3 DAS & 5-6 Leaf stage of weed.

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