



Efficient integrated weed management practices for higher productivity and profitability in vegetable pea (*Pisum sativum* var. *hortense*)

D P SINGH¹, RAJIV², MEENAKSHI KUMARI³ and H G PRAKASH⁴

Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208 002, India

Received: 01 April 2019; Accepted: 30 May 2019

ABSTRACT

A field experiment was conducted on vegetable pea (*Pisum sativum* L. var. *hortense*) at Vegetable Research Station, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during 2014–17 to develop efficient integrated weed management practices. Seven different treatments, viz. pendimethalin @0.75 kg a.i./ha (pre-emergence), pendimethalin @0.75 kg a.i./ha (pre-emergence) + one hand weeding at 40 DAS, glyphosate @1.0 kg a.i./ha 15 days before sowing, glyphosate @1.0 kg a.i./ha + one hand weeding at 40 DAS, mulching with black polythene, straw/grass mulch, hand weeding thrice at 20, 40 and 60 DAS were tested against two checks, i.e. weed free and weedy check (no weeding) in randomized block design with three replications. Vegetable pea variety 'Azad Pea-3' was used in the experiment. Crop was raised with recommended package of practices except treatments. Based on pooled data, among different treatments excluding weed free check, pendimethalin @0.75 kg a.i./ha (pre-emergence) + one hand weeding at 40 DAS recorded highest plant height (58.75 cm), seed weight/plant (12.73 g), number of seeds/pod (6.55), 100-seeds weight (31.93 g), seed yield (15.96 q/ha), seedling length (17.76 cm), seed vigour index-I (1619.92) and seed vigour index- II (13.17). In case of net return the same treatment also recorded significantly highest B:C ratio (2.30). Thus, pendimethalin @0.75 kg a.i./ha(pre-emergence) + one hand weeding at 40 DAS proved to be most profitable integrated weed management practice for vegetable pea.

Key words: Integrated weed management, Pre-emergence herbicide, Seed quality parameters, Seed yield, Vegetable pea

Vegetable pea (*Pisum sativum* var. *hortense*) is an important vegetable crop. It is grown in almost all agro-climatic zones during *rabi* season in plains and summer season in hills as cash crop. It is mainly grown for its tender green pods as a fresh vegetable. It is a rich source of protein, calcium, phosphorous, iron and vitamins. The vegetable pea productivity is severely affected by various biotic and abiotic factors. Among them, heavy weed infestation is the major biotic factor and constraint responsible for low seed yield as well as poor seed quality. Weeds compete with main crop for the use of nutrients, moisture, sunlight, space etc. hence, resulting in lower yield and poor quality (Jilani *et al.* 2003). Both grassy as well as broad leaved weeds infest the crop which results in significant yield losses in commercial crops (Singh *et al.*, 1991). Peas are poor competitors, particularly at the seedling stage but critical

period for crop-weed competition varies from 40–60 days after sowing, hence, avoiding early season weed interference is critical (Bhyan *et al.* 2004, Kumar *et al.* 2009). Due to weed competition more than 40% yield reductions in pea have been reported (Randhawa *et al.* 1980). Some authors reported yield reduction in the range of 37.3–64.4% (Tewari *et al.* 1997, Banga *et al.* 1998, Harker 2001). The integrated weed management is becoming popular among the farmers as they continue to realize the usefulness of herbicides along with few manual weeding. Bakht *et al.* (2009) found that newspaper and black mulch are effective tools to control weed. Application of pre-emergence herbicides effectively decreased weed density and resulted in higher pod yield (Sajid *et al.* 2012). Vaishya *et al.* (1999) reported that the post-emergence herbicides have long persistence and wide spectrum of weed control. Application of various herbicides significantly increased vegetable pea yield (79.6–85.1%) (Gurcharan *et al.* 1994). Keeping this in view, the present study was undertaken to develop efficient integrated weed management practices for pea.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2014–15, 2015–16 and 2016–17 at Vegetable Research Station of Chandra Shekhar Azad University of Agriculture

Present address: ¹Joint Director Research (dpsinghjdrcsa@gmail.com), ²Vegetable Agronomist (rajiv.agro69@gmail.com), Directorate of Research; ³Ph D Scholar (meenakshisinghupcs@gmail.com), ⁴Director Research (drhp1962@gmail.com), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, UP.

and Technology, Kanpur, India located at 26.4912° N latitude, 80.3071° E longitude at an elevation of 133 m amsl. Seven different treatments, viz. pendimethalin @0.75 kg a.i./ha (pre-emergence), pendimethalin @0.75 kg a.i./ha (pre-emergence) + one hand weeding at 40 DAS, glyphosate @1.0 kg a.i. /ha at 15 days before sowing, glyphosate @1.0 kg a.i. /ha + one hand weeding at 40 DAS, mulching with black polythene, straw/grass mulch, hand weeding thrice (at 20, 40 and 60 DAS) were tested against two checks, i.e. weed free and weedy check (no weeding) in randomized block design replicated thrice. Vegetable pea variety Azad Pea-3 was used in the experiment. Crop was raised with recommended package of practices except treatments. The recommended doses of nitrogen (40 kg/ha), phosphorus (60 kg/ha) and potassium (50 kg/ha) were applied. The crop was sown in the month of November during all three years at 30 × 10 cm spacing with the seed rate of 85 kg/ha. The observations were recorded as per the standard procedure.

Further, observations on seed quality parameters were observed as per standard procedure (ISTA 1993). Vigour index of the seeds was assessed based on germination percentage, seedling length and seedling dry weight as suggested by Abdul-Baki and Anderson (1973). Germination %, seedling length, seedling dry weight and vigour index (I & II) were calculated by using the following formulae:

$$\text{Germination (\%)} = \frac{\text{Number of normally germinated seeds} \times 100}{\text{Total number of seeds}}$$

Seedling length: Root and shoot length of five fresh seedlings was measured in centimeters up to one decimal. Total seedling length was calculated by adding root and shoot length.

Seedling dry weight: The seedlings used for recording were oven dried at 103°C+1°C for 12 h. Measurement of dried samples was record on an electronic balance up to three decimals in mg.

Table 1 Effect of integrated weed management practices on growth and yield attributes of vegetable pea

Treatment	Plant height (cm)				Seed weight/plant (g)				Number of seeds/pod				100-seeds weight (g)			
	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled
Pendimethalin @0.75 kg a.i./ha (pre emergence)	53.00	54.00	56.25	54.42	12.05	12.00	12.25	12.10	6.45	6.40	6.30	6.38	30.20	30.00	30.25	30.15
Pendimethalin @0.75 kg a.i. ha (pre-emergence) + one hand weeding (40 DAS)	58.00	58.00	60.25	58.75	12.80	12.75	12.65	12.73	6.56	6.50	6.60	6.55	32.05	32.00	31.75	31.93
Glyphosate @1.0 kg a.i./ha (15 DBS)	50.00	50.15	51.25	50.47	9.60	9.60	9.60	9.60	4.75	4.60	4.70	4.68	24.10	24.20	24.00	24.10
Glyphosate @1.0 kg a.i. /ha + one hand weeding (40 DAS)	47.00	48.25	47.75	47.75	10.20	10.30	10.35	10.28	4.76	4.80	4.80	4.79	25.53	25.60	24.75	25.29
Mulching with black polythene	54.00	54.00	56.00	54.67	12.20	10.20	10.25	10.88	6.35	6.25	6.30	6.30	30.52	30.50	30.50	30.51
Straw/grass mulch	53.00	54.50	56.25	54.58	12.35	12.30	12.40	12.35	6.26	6.24	6.20	6.23	30.95	30.80	31.20	30.98
Hand weeding thrice (20, 40 and 60 DAS)	58.00	57.00	59.00	58.00	12.20	12.30	12.30	12.27	6.46	6.50	6.60	6.52	30.55	30.45	31.00	30.67
Weed free check	60.00	61.50	62.75	61.42	13.45	13.25	13.00	13.23	6.56	6.70	6.70	6.65	33.82	33.85	34.00	33.89
Weedy check (No weeding)	49.00	47.75	47.75	48.17	7.90	7.50	7.75	7.72	4.55	4.50	4.60	4.55	19.75	20.00	22.15	20.63
SEm±	1.53	1.03	0.60	1.04	0.35	0.54	0.23	0.26	0.05	0.16	0.17	0.16	0.42	0.40	0.26	0.45
CD (P=0.05)	4.48	3.00	1.77	3.03	1.01	1.60	0.68	0.77	0.16	0.49	0.50	0.48	1.24	1.19	0.76	1.32

Vigour Index (I) = Germination percentage $\times$ Seedling length (cm)

Vigour Index (II) = Germination percentage $\times$ Dry weight (mg)

RESULTS AND DISCUSSION

Growth and yield attributes: Vegetable pea growth and yield attributes were influenced significantly by different treatments (Table 1). Herbicide alone or along with one hand weeding, mulching and hand weeding thrice (at 20, 40 and 60 DAS) proved better for growth and yield attributes than the weedy check. Among seven tested treatments, pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS recorded significantly highest plant height of 58.75 cm. It was followed by hand weeding thrice and mulching with black polythene. In case of seed weight/plant also, pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40

DAS showed highest seed weight/plant (12.73 g) followed by straw/grass mulch and hand weeding thrice. Similar trend was also observed in case of number of seeds/pod and 100-seeds weight.

The results of the study revealed that the growth and yield attributes of vegetable pea increased significantly with pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS. It might be due to better weed management during the cropping period, which helped in minimum competition between crop plant and weed for moisture and nutrients as these are basic requirements for healthy plant growth. Sultana *et al.* (2009) and Rana *et al.* (2007) in vegetable pea also reported similar results. Brijbhoshan *et al.* (2017) also reported that one hand weeding at 25 DAS reduced the density and dry matter of weeds significantly and increased the yield attributes and seed yield.

The growth and yield attributes of vegetable pea

Table 2 Influence of integrated weed management practices on seed yield and seed quality of vegetable pea

Treatment	Seed yield (q/ha)				Seedling length (cm)				Dry weight of seedling (g)				Germination (%)			
	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled
Pendimethalin @0.75 kg a.i./ha (pre-emergence)	14.98	14.75	15.00	14.91	16.40	16.20	16.50	16.37	0.13	0.15	0.16	0.15	90.10	90.00	90.50	90.20
Pendimethalin @0.75 kg a.i./ha (pre-emergence) + one hand weeding (40 DAS)	15.93	16.00	15.95	15.96	17.63	17.80	17.85	17.76	0.14	0.16	0.16	0.15	90.18	92.00	92.00	91.39
Glyphosate @1.0 kg a.i./ha (15 DBS)	11.93	12.25	12.75	12.31	15.48	15.50	15.50	15.48	0.12	0.12	0.13	0.12	88.00	88.00	89.00	88.33
Glyphosate @1.0 kg a.i./ha + one hand weeding (40 DAS)	12.65	12.40	12.40	12.48	14.57	14.60	15.00	14.72	0.12	0.12	0.13	0.12	88.10	88.00	88.50	88.20
Mulching with black polythene	15.17	15.20	15.25	15.21	16.71	16.75	16.75	16.74	0.13	0.14	0.13	0.13	89.70	89.00	89.00	89.23
Straw/grass mulch	15.15	15.25	15.50	15.30	16.40	16.40	16.50	16.43	0.13	0.13	0.14	0.13	89.90	89.50	90.00	89.80
Hand weeding thrice (20, 40 and 60 DAS)	15.35	15.30	15.30	15.32	17.62	17.75	17.80	17.72	0.14	0.15	0.15	0.15	90.05	90.00	90.00	90.02
Weed free check	16.75	16.70	16.75	16.73	17.96	18.00	18.25	18.07	0.14	0.15	0.15	0.15	90.06	91.00	91.50	90.85
Weedy check (No weeding)	9.76	10.00	10.25	10.00	15.18	15.20	15.00	15.13	0.12	0.14	0.14	0.13	89.87	90.00	90.00	89.96
SEm $\pm$	0.18	0.63	0.26	0.29	0.13	0.48	0.22	0.21	0.003	0.006	0.003	0.003	0.48	0.55	0.50	0.51
CD (P=0.05)	0.55	1.85	0.79	0.84	0.37	1.41	0.64	0.61	0.01	0.02	0.01	0.01	1.39	1.60	1.45	1.51

Table 3 Influence of integrated weed management practices on seedling vigour index and B:C ratio of vegetable pea

Treatment	Seed Vigour Index – I				Seed Vigour Index – II				B:C ratio
	2014-15	2015-16	2016-17	Pooled	2014-15	2015-16	2016-17	Pooled	
Pendimethalin @0.75 kg a.i./ha (pre-emergence)	1477.62	1458.03	1493.17	1476.27	11.71	13.51	14.03	13.08	2.26
Pendimethalin @0.75 kg a.i./ha (pre-emergence) + one hand weeding (40 DAS)	1588.97	1633.00	1637.80	1619.92	12.52	13.50	13.50	13.17	2.30
Glyphosate @1.0 kg a.i./ha (15 DBS)	1362.19	1363.70	1379.58	1368.49	10.74	10.56	11.13	10.81	1.76
Glyphosate @1.0 kg a.i./ha + one hand weeding (40 DAS)	1283.60	1285.10	1327.50	1298.73	10.13	10.13	11.06	10.44	1.58
Mulching with black polythene	1498.88	1491.17	1490.73	1493.59	11.54	12.02	11.57	11.71	1.61
Straw/grass mulch	1474.38	1466.00	1485.00	1475.13	11.60	11.62	12.15	11.79	1.87
Hand weeding thrice (20, 40 and 60 DAS)	1587.61	1602.00	1606.54	1598.72	12.70	12.74	13.27	12.90	1.79
Weed free check	1617.48	1637.87	1669.67	1641.67	12.63	14.72	14.71	14.02	1.85
Weedy check (No weeding)	1364.24	1367.97	1350.05	1360.75	10.69	12.61	12.15	11.82	1.30
SEm±	13.94	32.73	22.13	25.31	0.27	0.64	0.33	0.32	0.07
CD (P=0.05)	40.58	96.25	64.41	74.03	0.79	1.88	0.96	0.94	0.21

performed well to hand weeding thrice (at 20, 40 and 60 DAS) which might be due to effective weed management. Similar results were obtained by Muhammad *et al.* (2011) in chickpea and conveyed that three-hand weeding in a crop period effectively controlled weed density up to 96.22% in chickpea. The lower values of growth and yield attributes under the treatment of glyphosate alone or along with one hand weeding were mainly due to toxic effect of glyphosate, which is broad-spectrum herbicide and hinder the photosynthetic activity of plant leads to reduced growth and yield attributes. The weedy check recorded minimum values of all traits due to excess weed population, which leads to more competition with crop plant for moisture and nutrient.

Seed yield: Seed yield of the vegetable pea was influenced significantly by different treatments (Table 2). Herbicide alone or along with one hand weeding, mulching and hand weeding thrice also proved better for seed yield than the weedy check. Among seven different tested treatments, pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS recorded significantly highest seed yield of 15.96 q/ha followed by hand weeding thrice (at 20, 40 and 60 DAS) and mulching with straw/grass. Although, the seed yield was maximum in weed free check (16.73 q/ha) however was statistically at par with pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS. The yield enhancement under the treatment of pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS over the treatment of weedy check was to the tune 5.96 q/ha or 59.6%. These results were similar to the outcomes of Mathukia *et al.* (2015).

Seed quality parameters: The pooled analysis showed that the seed quality parameters were significantly affected by different weed management practices (Table 2 and 3). Among tested treatments, pre-emergence application

of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS also recorded higher values of seed quality parameters, viz. seedling length (17.76 cm), seed vigour index-I (1619.92) and seed vigour index-II (13.17) followed by hand weeding thrice (at 20, 40 and 60 DAS). Similar trend was also observed in case of germination %. Kumar and Singh (1994) also found the same result while using pendimethalin @0.5 kg/ha along with one hand weeding.

Economics: Net return is the resultant of gross income and cost of cultivation where gross income dominated cultivation cost in present study. Pre-emergence application of pendimethalin @0.75 kg a.i./ha + one hand weeding at 40 DAS registered significantly highest B:C ratio (2.30) followed by pendimethalin @0.75 kg a.i./ha alone. It might be due to higher gross income in these treatments. Although, the seed yield was maximum in weed free check but B:C ratio of this weed management practice is very poor as more manpower requirement increases the cost of cultivation.

It can be inferred that pre-emergence (PE) application of pendimethalin @0.75 kg a.i./ha alone or along with one hand weeding at 40 DAS are profitable weed management practices in vegetable pea for agro-climatic condition of Zone- IV.

REFERENCES

- Abdul-Baki AA and Anderson J D. 1973. Vigor determination in soybean seed by multiple criteria. *Crop Science* **13**: 630–3.
- Bakht T, Khan I A, Khan M I, Khan I and Khattak A M. 2009. Weed control in pea (*Pisum sativum* L.) through mulching. *Pakistan Journal of Weed Science Research* **15**(1): 83–9.
- Banga R S, Yadav A and Malik R S. 1998. Evaluation of different herbicides for weed control in pea (*Pisum sativum* L.). *Indian Journal of Weed Science* **30**: 145–8.
- Bhyan B S, Batra V K, Singh J and Thakral K K. 2004. Effect of weed competition on quality of pea seed. *Haryana Journal of Horticultural Sciences* **33**(1-2): 130–1.
- Brijbhoshan, Shalini and Singh V K. 2017. Weed dynamics and

- yield of fieldpea (*Pisum sativum* var. *arvense*) as influenced by planting methods, irrigation schedule and weed management practices. *International Journal of Pure and Applied Bioscience* **5**(2): 129–36.
- Gurcharan S H, Kundra C, Brar L S, Gupta R P and Singh G. 1994. Effect of herbicides on soil microorganism dynamics, Rhizobium-legume symbiosis and grain yield of pea (*Pisum sativum*). *Indian Annals of Agricultural Research* **15**(1): 22–6.
- Harker K N. 2001. Survey of yield losses due to weeds in central Alberta. *Canadian Journal of Plant Science* **81**: 339–42.
- ISTA. 1993. International rules for seed testing. *Seed Science and Technology* **21**: 288–96.
- Jilani M S, Ghaffoor A and Rehman S. 2003. Conventional and chemical control of weeds in five cultivars of transplanted onion. *Pakistan Journal of Weed Science Research* **9**(3-4): 215–24.
- Kumar A, Sharma B C, Nandan B and Sharma P K. 2009. Crop weed competition in field pea under rain fed subtropical conditions of Kandi belt of Jammu. *Indian Journal of Weed Science* **41**: 23–6.
- Kumar S and Singh C M. 1994. Integrated weed management in vegetable pea (*Pisum sativum*) under dry temperate condition. *Indian Journal of Weed Science* **26**: 40–4.
- Mathukia R K, Gadhiya V and Panara D M. 2015. Weed management in field pea (*Pisum sativum* L.). *Journal of Crop and Weed* **11**: 177–80.
- Muhammad N, Sattar A, Ashiq M and Ahmad I. 2011. Efficacy of pre and post emergence herbicides to control weeds in chickpea (*Cicer arietinum* L.). *Pakistan Journal of Weed Science Research* **17**(1): 17–24.
- Rana M C, Singh A, Rana S S and Kumar N. 2007. Integrated weed management in pea (*Pisum sativum* L.) under Lahaul Valley condition of Himachal Pradesh. *Indian Journal of Agronomy* **77**: 59–61.
- Randhawa K S, Saimbhi M S and Singh B. 1980. Chemical weed control in seed crop of pea (*Pisum sativum* L.). *Indian Journal of Weed Science* **12**: 186–90.
- Sajid M, Rab A, Amin N U, Wahid F, Jan I, Ahmad I, Khan I A and Khan M.A. 2012. Effect of herbicides and row spacing on the growth and yield of pea. *Pakistan Journal of Weed Science Research* **18**(1): 1–13.
- Singh J S, Bhan V M and Balyan R S. 1991. Crop weed studies in pea. *Indian Journal of Weed Science* **23**(1-2): 67–8.
- Sultana S, Ulah M J, Karim M F and Asaduzzaman M. 2009. Response of mungbean to integrated nitrogen and weed management. *American-Eurasian Journal of Agronomy* **2**: 104–8.
- Tewari A N, Hussain N K and Singh B. 1997. Evaluation of herbicides in pea (*Pisum sativum*) + mustard (*Brassica juncea*) intercropping. *Indian Journal of Weed Science* **29**: 94–7.
- Vaishya R D, Rai O P and Singh R K. 1999. Weed control in pea with pre and post emergence herbicides. *Indian Journal of Pulses Research* **12**: 201–5.