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Evaluation of imazethapyr and its ready mix combinations for weed control in okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

The bio-efficiency of imazethapyr and its ready mix combination with imazamox against weeds, their effect on growth, development and yield of okra crop were studied at Palampur during kharif 2016. The major weed flora of the experimental field was composed of Echinochloa colona, Panicum dichotomiflorum, Gallinsoga parviflora, Commelina benghalensis and Cyperus rotundus constituting 7.4, 13.1, 14.1, 27.1 and 34.6 per cent, respectively. Hand weeding twice had lower count of Cyperus rotundus. Pendimethalin 1000 g ha^{-1} (pre-emergence) fb hand weeding (HW) (30 DAS) and pendimethalin 1500 g ha^{-1}, hand weeding twice (30 and 45 DAS), pendimethalin 1500 g ha^{-1} and pendimethalin 1000 g ha^{-1} fb imazethapyr + imazamox 60 g ha^{-1} (post-emergence) was significantly superior to other treatments in reducing the count of Commelina benghalensis upto 90 days after sowing (DAS).Pendimethalin 1000 g ha^{-1} (pre-emergence) fb hand weeding (HW) at 30 days after sowing (DAS), hand weeding and pendimethalin 1500 g ha^{-1} effectively controlled Gallinsoga parviflora. Pendimethalin1000 g ha^{-1} (pre-emergence) fb hand weeding (HW) at 30 (DAS) had the lowest population of Panicum dichotomiflorum. Pendimethalin 1000 g ha^{-1} (pre-emergence) fb hand weeding at 30 (DAS), pendimethalin 1500 g ha^{-1} (pre-emergence) and hand weeding (30&45 DAS) resulted in significantly lower total weed count.Pendimethalin 1000 g ha^{-1} (pre) fb hand weeding (30 DAS), hand weeding (30 and 45 DAS) and pendimethalin 1500 g ha^{-1} (pre) alone produced taller plants of okra compared to other treatments. Treatments having imazethapyr as a part significantly reduced the plant height probably owing to phytotoxicity. Hand weeding (30 and 45 DAS), pendimethalin (pre) 1000 g ha^{-1} fb hand weeding (30 DAS) and pendimethalin (pre) 1500 g ha^{-1} alone were earlier in days to 50% flowering and days to first picking. Phytotoxicity induced by imazethapyr resulted in significantly lower final plant stand in the treatments constituting of it. Pendimethalin (pre) 1000 g ha^{-1} fb hand weeding (30DAS) and pendimethalin (pre) 1500 g ha^{-1} alone had more number of fruits/plant than other treatments. Pendimethalin 1000 g ha^{-1} (pre) fb hand weeding (30 DAS) remaining at par with imazethapyr + pendimethalin 1200 g ha^{-1} (pre) and pendimethalin 1500 g ha^{-1} (pre) alone resulted in significantly higher fresh fruit yield/plant and fruit yield per hectare over the other weed control treatments. The fresh fruit yield per plant under weedy check was only 18% of that under pendimethalin 1000 g ha^{-1} (pre-emergence) fb hand weeding indicating.

Keywords: *Imazethapyr, pendimethalin,* okra, weeds

In Himachal Pradesh, okra is cultivated in summer or rainy season crop under low and mid hills covering about 2.76 thousand hectares with a production of 34.03 thousand metric tonnes (Anonymous, 2016). Allelopathy and competition by weeds is the major limiting factor in realizing its potential yield (Ameena *et al*., 2015; Kumar *et al*., 2010). In rainy season crop, weed problem is very serious on account of delayed crop emergence, frequent rains and high soil fertility which provide congenial conditions for their growth and development. Secondly, wider spacing for rainy season crop also offers ample opportunities for weed infestation resulting in huge reduction in yield and quality of the produce. The yield losses due to weeds varied from 40 to 80% depending on the type of weed flora, their intensity and stage (Jalendhar *et al*., 2016; Sah *et al*., 2018). Weeds can be effectively controlled with the application of pre-emergence herbicides at critical period of crop weed competition without any phytotoxicity (Kumar *et al*., 2010). However, the continuous application of pre-emergence herbicides in crops alters annual-perennial balance in favour of perennial weeds. Notwithstanding, annual weeds offer the lion's share of competition in majority of the crop-field situations at the early part of the crop growth and remain as the main dominating weeds constituted of composite flora of plants. Use of pre-emergence herbicides at low doses in conjunction with manual weeding at 30-40 days after seeding is environmentally safe, socially acceptable and economically viable (Kumar *et al*., 2011). However, unavailability of labour at critical period of crop-weed competition and sometimes unfavorable field conditions do not permit manual weeding. In literature, sufficient information on pre-emergence herbicides to control weeds in okra has been reported from various quarters but the information on post-emergence herbicides or their combinations is lacking.Many a times, extension workers and farmers demand information on post-

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emergence herbicides or their combinations particularly when they fail to spray pre-emergence herbicides due to one or other reasons and paucity of labour for manual weeding. Hence, it becomes imperative to identify appropriate herbicide(s) and their combinations to manage the complex weed flora in okra.

MATERIALS AND METHODS

The field experiment was conducted at Experimental Farm of the Department of Vegetable Science and Floriculture, CSK HPKV, Palampur [32^{0}6′ North latitude and 76^{0}3′ East longitude and 1290 m above mean sea level] during *kharif*, 2016. The site is falling under mid-hill zone of Himachal Pradesh. The soil of this zone is of podzolic type with pH range of 5.0-6.0. Soil of experimental field was silty clay loam in texture, acidic in reaction, medium in organic carbon (0.71%), medium in available nitrogen (407 kg ha^{-1}), phosphorus (17.2 kg ha^{-1}) and potassium (162 kg ha^{-1}). During the growing season (May, 2016 to September, 2016), monthly maximum and minimum temperature ranged between 24.6 to 32.7°C and 15.7 to 25.5°C, respectively. The total rainfall during the cropping season was 2851 mm in a period of 150 days. The average relative humidity during morning and evening ranged between 42.4 to 96.7 per cent and 34.0 to 94.4 per cent, respectively. The sowing of healthy and disease free seeds of okra var. Palam Komal was done on May 20, 2016 at 50 cm row to row and 10 cm plant to plant spacing with the help of khurpi. FYM 25 t ha^{-1} was applied before field preparation. In addition, chemical fertilizers were applied at 75 kg N, 50 kg P_2O_5 and 55 Kg K_2O per hectare in the form of Urea, Single Super Phosphate and Muriate of Potash, respectively. Half of the nitrogen along with full dose of phosphorus and potassium were applied at the time of sowing as basal dose. The remaining nitrogen was top dressed in two equal splits each at 30 and 45 days after sowing (DAS). Pre-sowing irrigation was given for better germination and better establishment of the crop. Subsequently, the field was irrigated at an interval of 10-12 days depending upon requirement of the crop and weather conditions. Twelve treatment combinations *viz*., pendimethalin (pre) 1500 g ha^{-1}, pendimethalin (pre) 1000 g ha^{-1} *fb* imazethapyr (post) 100 g ha^{-1}, imazethapyr (pre) 100 g ha^{-1} *fb* imazethapyr (post) 100 g ha^{-1}, imazethapyr + pendimethalin (pre) 1200 g ha^{-1}, imazethapyr + pendimethalin (pre) 1500 g ha^{-1}, imazethapyr + pendimethalin (pre) 1000 g ha^{-1} *fb* imazethapyr (post) 100 g ha^{-1}, imazethapyr + imazamox (post) 60 g ha^{-1}, imazethapyr + imazamox (post) 90 g ha^{-1}, pendimethalin (pre) 1000 g ha^{-1} *fb*imazethapyr + imazamox(post) 60 g ha^{-1}, pendimethalin (pre) 1000 g ha^{-1} *fb* HW (30 DAS), hand weedings (30 and 45 DAS) and weedy check were evaluated in a randomized block design with three replications. Hand weeding and shallow hoeing was done as per treatment schedule. Herbicidal sprays as per treatments were applied immediately after sowing (pre-emergence) and 30 days after sowing (post-emergence) with the help of knapsack sprayer using flat fan nozzle in 750 liters of water per hectare. The crop was harvested during marketable stage at different time intervals from August 18 to September 25, 2016 with the help of secateur.

Species-wise weed count was recorded at 30, 60, 90, 120 days after sowing (DAS) and at harvest. Growth, yield attributes and yield were recorded at different growth and harvest times.The data were subjected to statistical analysis as per Panse and Sukhatme (1984) and the treatments were compared at 5 per cent level of significance to interpret the differences. The weed count data were analyzed after subjecting the original data to square root transformation *i.e.* $\sqrt{(x+0.5)}$ and the treatment effects were compared using transformed means.

RESULTS AND DISCUSSION

The major weed flora of the experiment field was comprised of *Cyperus rotundus* (34.61%), *Commelina benghalensis* (27.14%), *Gallinsoga parviflora* (14.1%), *Panicum dichotomiflorum* (13.1%) and *Echinochloa colona* (7.44%). *Digitaria sanguinalis, Eleusine indica* and *Bidens pilosa* were the other important weeds found growing in association with the crop. Grassy weeds *viz*., *Cynodon dactylon, Digitari a sanguinalis, Eleusine indica, Echinochloa colona, Commelina benghalensis* and *Panicum dichotomiflorum* were more pre dominant than broad-leaf weeds (*Polygonum sp.*, *Bidens pilosa* and *Phyllanthus niruri.)*. The weed count in general was maximum at 90 days after sowing (DAS) and gradually decreased thereafter.

Effect on weeds

All weed control treatments except imazethapyr + imazamox 60 g ha^{-1} (post-emergence) and imazethapyr + imazamox 90 g ha^{-1} (post-emergence) had significantly lower population of *Cyperus rotundus* over weedy check (Table 1). Hand weeding twice had lower count of *Cyperus rotundus*. Pendimethalin 1000 g ha^{-1}(pre-emergence) *fb* hand weeding (HW) (30 DAS) and pendimethalin 1500 g ha^{-1} being statistically similar, resulted in significantly lower count of this weed among herbicidal treatments. Similar observations with respect to hand weeding at 20-25 and 40-45 days after sowing(DAS) on the count of *Cyperus rotundus* were recorded by Walia (2003) and Rana *et al*.(2013).\

Hand weeding twice (30 and 45 DAS), pendimethalin 1500 g ha^{-1} and pendimethalin 1000

Table 1: Effect of weed control treatments on count (No./m^2) of weeds at maximum population stage *i.e.*90 DAS

Treatment	Dose (g/ha)	Time	*Commelina*	*Gallinsoga*	*Cyperus*	*Panicum*	*Echinochloa*
Pendimethalin	1500	Pre	3.6 (16)	3.6 (16)	5.4 (32.0)	3.1 (10.7)	3.1 (10.7)
Pendimethalin*fb*imazethapyr	1000 *fb* 100	Pre *fb* post	5.2 (26.7)	4.7 (21.3)	7.7 (58.7)	4.7 (21.3)	3.6 (16.0)
Imazethapyr*fb*imazethapyr	100 *fb* 100	Pre *fb* post	6.6 (48.0)	5.6 (32.0)	9.4 (90.7)	5.2 (26.7)	3.6 (16.0)
Imazethapyr + pendimethalin	1200	Pre	6.8 (42.7)	5.1 (26.7)	8.4 (74.7)	5.1 (26.7)	4.7 (21.3)
Imazethapyr + pendimethalin	1500	Pre	7.6 (58.7)	6.0 (37.3)	10.2 (106.7)	6.0 (37.3)	5.2 (26.7)
Imazethapyr + pendimethalin*fb*imazethapyr	1000 *fb* 100	Pre *fb* post	9.3 (85.3)	6.5 (42.7)	10.7 (117.3)	6.2 (37.3)	5.2 (26.7)
Imazethapyr + imazamox	60	Post	9.5 (90.7)	7.2 (53.3)	12.0 (144.0)	6.9 (48.0)	5.6 (32.0)
Imazethapyr + imazamox	90	Post	10.9 (122.7)	7.7 (58.7)	12.6 (160.0)	7.2 (53.3)	5.6 (32.0)
Pendimethlin*fb* imazethapyr + imazamox	1000 *fb* 60	Pre *fb* post	3.6 (16.0)	5.2 (26.7)	8.2 (69.3)	4.2 (21.3)	6.2 (37.3)
Pendimethalin*fb* hand weeding	1000	Pre *fb* HW 30 DAS	4.2 (21.3)	3.1 (10.7)	3.6 (16.0)	3.1 (10.7)	3.1 (10.7)
Hand weeding Twice	-	30&45DAS	3.6(16.0)	3.6(16.0)	6.4(42.7)	3.6(16.0)	3.6(16)
Weedy check	-	-	12.4 (157.7)	8.8 (80.0)	14.0 (197.3)	8.6 (74.7)	6.4 (42.7)
CD (P=0.05)	-	-	2.99	3.0	3.06	3.05	NS

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

g ha^{-1} *fb* imazethapyr + imazamox 60 g ha^{-1} (post-emergence) was significantly superior to other treatments in reducing the count of *Commelina benghalensis* upto 90 days after sowing (DAS). Pendimethalin 1000 g ha^{-1} *fb* hand weeding (HW) (30 DAS) being statistically similar to pendimethalin 1000 g ha^{-1} (pre-emergence) *fb* imazethapyr 100 g ha^{-1} (post-emergence), imazethapyr 100 g ha^{-1} (pre-emergence) *fb* imazethapyr 100 g ha^{-1} (post-emergence) and imazethapyr + pendimethalin 1200 g ha^{-1} (pre-emergence) resulted in significantly superior control of *Commelinabenghalensis* over other herbicidal treatments. The activity of pendimethalin*fb* hand weeding (HW) against *Commelina benghalensis* has been well established (Bhullar *et al*., 2015).

Pendimethalin 1000 g ha^{-1}(pre-emergence)*fb* hand weeding (HW) at 30 days after sowing(DAS) being statistically at par with hand weeding twice (30 and 45 DAS), pendimethalin 1500 g ha^{-1} (pre-emergence), pendimethalin 1000 g ha^{-1} (pre-emergence) *fb*imazethapyr 100 g ha^{-1} (post-emergence), imazethapyr + pendimethalin 1200 g ha^{-1} (pre-emergence) and pendimethalin 1000 g ha^{-1} (pre-emergence) *fb*imazethapyr + imazamox 60 g ha^{-1} (post-emergence) was significantly superior to other treatments in reducing the count of *Gallinsoga parviflora* upto 90 days after sowing (DAS). The activity of imazethapyr against *Gallinsoga parviflora* has been well established (Pandey, 1989). The other treatments could not significantly reduce the count of this weed over weedy check. Pendimethalin1000 g ha^{-1} (pre-emergence) *fb* hand weeding (HW) at 30 days after sowing (DAS) had the lowest population of *Panicum dichotomiflorum* among all the treatments. Similar observations with respect to weed free on count of *Panicum dichotomiflorum* were recorded by Lemerle *et al*. (2006). *Echinochloa colona* proportionally had lower population than other weeds. Distribution of the weed appeared to be sporadic rather than uniform and as a matter of fact, it did not vary significantly due to weed control treatments at its maximum population stage inspite of having wide variation.

Owing to reduction in species-wise weed count, weed control treatments gave significant reduction in total weed count as compared to weedy check (Fig 1). The treatment combinations, pendimethalin 1000 g ha^{-1} (pre-emergence) *fb* hand weeding at 30 days after sowing (DAS), pendimethalin 1500 g ha^{-1} (pre-emergence) and hand weeding (30 & 45 DAS) resulted in significantly lower total weed count among all treatments. Choudhry *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. This was due to effective suppression of newly emerging grasses, sedges and broad-leaved weeds by the application of pre emergence herbicides after sowing of okra. Tamang *et al*. (2015) also observed that Valor

32 EC (pendimethalin 30 EC + imazethapyr 2 EC), pendimethalin and imazethapyr were as effective as hand weeding twice *i.e* 20 and 40 days after sowing (DAS) for controlling grassy weeds in green gram. Kumar *et al*. (2014) reported that the relative suppressive effect of imazethapyr was in the order of grassy weed>sedges>broad-leaf weeds. However, the study suggested a dose of 100 g ha^{-1} for effective suppression of *Cyperus sp.* and the other diverse weed flora. Instead of single herbicide pendimethalin (pre-emergence), a combined application of pre emergence pendimethalin at 1.0 kg ha^{-1}+ imazethapyr at 100 g ha^{-1} at 30 days after sowing (DAS) was a useful treatment giving adequate control of weeds especially in *kharif* mung bean, urdbean and pigeon pea (Autar *et al*., 2013).

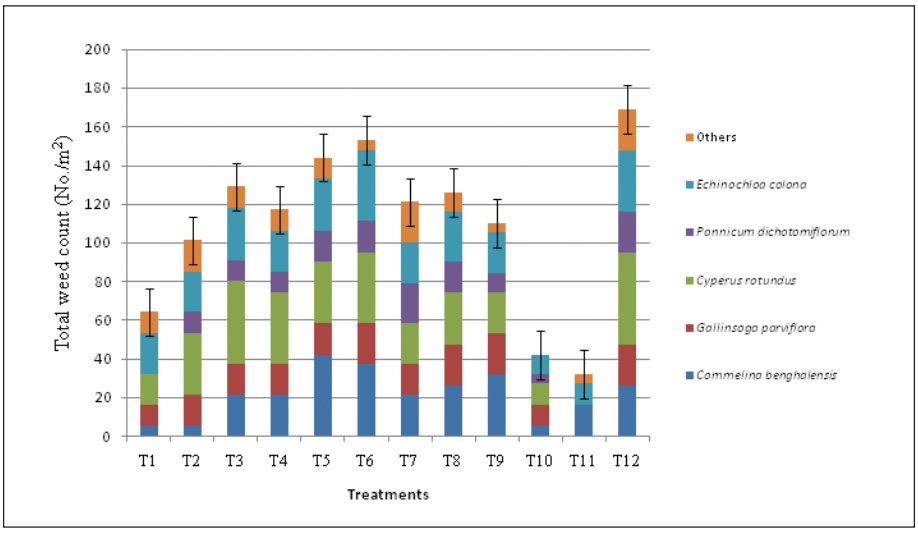

Fig. 1: Effect of weed control treatments on total weed count at 90 DAS [Error bars indicate standard error (n=11); LSD (P=0.05) for treatment difference = 11.2 m^{-2}]

Table 2: Effect of treatments on emergence (No./m^2) of crop, days to 50% flowering and plant height *i.e.* 120 DAS and other developmental parameters

Treatment	Dose (g ha^{-1})	Time	Emergence count	Plant height (cm)	Days to 50% flowering	Days to first picking	Harvest duration	Node at which first flower appears
Pendimethalin	1500	Pre	43.3	121.6	49.3	60	40	4.7
Pendimethalin*fb*imazethapyr	1000 *fb* 100	Pre *fb* post	34.7	85.8	53.7	62	37	5.3
Imazethapyr*fb*imazethapyr	100 *fb* 100	Pre *fb* post	34.3	78.6	58.7	67	31	3.7
Imazethapyr + pendimethalin	1200	Pre	36.3	80.0	59.3	73	32	4.1
Imazethapyr + pendimethalin	1500	Pre	25	71.0	63.3	79	29	4.3
Imazethapyr + pendimethalin *fb*imazethapyr	1000 *fb* 100	Pre *fb* post	39	63.0	69	80	29	4.4
Imazethapyr + imazamox	60	Post	33	58.7	69.3	80	27	4.3
Imazethapyr + imazamox	90	Post	40.3	49.3	71.3	77	26	4.7
Pendimethlin*fb* imazethapyr + imazamox	1000 *fb* 60	Pre *fb* post	32.7	63.3	56.3	62	33	5.6
Pendimethalin*fb* hand weeding	1000	Pre *fb* HW 30 DAS	36.3	154.7	48.3	60	42	3.4
Hand weeding Twice	-	30&45 DAS	40	120.3	48	60	38	3.6
Weedy check	-	-	41.3	36.0	74	83	26	5.1
CD (P=0.05)	-	-	NS	5.4	4.3	4.9	2.4	1.1

Effect on crop

Emergence count was not significantly affected due to weed control treatments (Table 2).Pendimethalin 1000 g ha^{-1} (pre) *fb* hand weeding (30 DAS), hand weeding (30 and 45 DAS) and pendimethalin 1500 g ha^{-1} (pre) alone produced taller plants of okra compared to other treatments. Treatments having imazethapyr as a part significantly reduced the plant height, probably owing to phytotoxicity induced by the herbicide. The treatments having imazethapyr as an ingredient such as pendimethalin 1000 g ha^{-1} (pre-emergence) *fb*imazethapyr 100 g ha^{-1} (post-emergence), imazethapyr 100 g ha^{-1} (pre-emergence) *fb*imazethapyr 100 g ha^{-1} (post-emergence), imazthapyr + pendimethalin 1200

Table 3: Effect of treatments on fruit yield and yield attributes of okra

Treatment	Dose (g/ha)	Time	Final plant population (No./m^2)	Fruit length (cm)	Fruit diameter (cm)	Fruits/ plant	Fruit weight (g)	Nodes/ plant	Internodal length (cm)	Yield/ plant (g)
Pendimethalin	1500	Pre	18.7	11.7	1.8	9.0	13.0	7.3	7.3	124.3
Pendimethalin*fb*imazethapyr	1000 *fb* 100	Pre *fb* post	17.7	12.3	1.8	7.3	15.0	1.0	7.7	113.7
Imazethapyr*fb*imazethapyr	100 *fb* 100	Pre *fb* post	13.3	9.0	2.0	5.7	14.0	12.0	6.0	77.3
Imazethapyr + pendimethalin	1200	Pre	11.7	8.7	1.4	5.3	12.0	12.7	6.0	138.7
Imazethapyr + pendimethalin	1500	Pre	13.7	10.3	1.9	5.0	12.0	8.7	7.7	109.7
Imazethapyr + pendimethalin *fb*imazethapyr	1000 *fb* 100	Pre *fb* post	10.3	8.0	1.4	4.3	10.0	13.0	4.3	45.0
Imazethapyr + imazamox	60	Post	6.3	8.7	1.8	3.0	13.0	13.7	3.7	40.0
Imazethapyr + imazamox	90	Post	5.3	10.7	1.4	3.3	11.0	10.0	4.3	37.0
Pendimethlin*fb* imazethapyr + imazamox	1000 *fb* 60	Pre *fb* post	13.7	11.7	1.7	6.0	12.7	10.7	5.3	74.3
Pendimethalin*fb* hand weeding	1000	Pre *fb* HW 30DAS	14.7	12.7	2.0	9.3	16.3	17.0	8.7	157.7
Hand weeding twice	-	30&45DAS	19.7	12.3	2.0	7.3	15.7	17.0	6.3	119.7
Weedy check	-	-	4.3	8.0	1.3	2.3	11.7	12.3	2.3	28.0
CD (P=0.05)	-	-	3.2	2.1	NS	1.0	1.6	3.4	1.7	36.3

g ha^{-1} (pre-emergence), imazathapyr + pendimethalin 1500 g ha^{-1} (pre-emergence), imazethapyr + pendimethalin 1000 g ha^{-1} (pre-emergence) *fb*imazethapyr 100 g ha^{-1} (post-emergence), imazethapyr + imazamox 60 g ha^{-1} (post-emergence), imazethapyr + imazamox 90 g ha^{-1} (post-emergence), pendimethalin 1000 g ha^{-1} (pre-emergence) *fb* imazethapyr + imazamox 60 g ha^{-1} (pre-emergence) had lower plant height probably owing to the reverse metabolism, phytotoxicity. The emergence count discussed earlier was not significantly affected. Imazethapyr+ imazamox had comparatively more prominent effect on reduction in plant height than imazethapyr + pendimethalin. Pendimethalin 1000 g ha^{-1}(pre-emergence) *fb* imazethapyr 100 g ha^{-1} (post-emergence), imazethapyr + pendimethalin 1200 g ha^{-1} (pre-emergence) had an edge over other treatments in influencing plant height of okra at 120 days after sowing. The results are in accordance with the findings of earlier researchers (Kundra and Gill, 1990).

Hand weeding (30 and 45 DAS), pendimethalin (pre) 1000 g ha^{-1} *fb* hand weeding (30 DAS) and pendimethalin (pre) 1500 g ha^{-1} alone were earlier in days to 50% flowering and days to first picking. Most of other herbicidal treatments also brought about earliness in these traits over the weedy check. Pendimethalin (pre) 1000 g ha^{-1} *fb* hand weeding (30 DAS) and pendimethalin (pre) 1500 g ha^{-1} alone being at par had longer harvest duration than the weedy check. Pendimethalin 1000 (pre) g ha^{-1} *fb* hand weeding (30 DAS), hand weeding twice (30 and 45DAS) and imazethapyr 100 g ha^{-1} (pre) *fb*imazethapyr 100 g ha^{-1} (post) bore first flower at the lower node than other treatments.

Phytotoxicity induced by imazethapyr resulted in significantly lower final plant stand in the treatments constituting it (Table 3). Hand weeding (30 and 45 DAS), pendimethalin 1500 g ha^{-1} alone (pre) and pendimethalin 1000 g ha^{-1} (pre) *fb*imazethapyr 100 g ha^{-1} (post) had higher final plant population than other treatments. Pendimethalin 1500 g ha^{-1} (pre) alone, hand weeding (30 and 45 DAS), pendimethalin 1000 g ha^{-1} (pre) *fb* imazethapyr 100 g ha^{-1} (post), imazethapyr + imazamox 90 g ha^{-1} (post), imazethapyr + pendimethalin 1500 g ha^{-1} (pre), imazethapyr 100 g ha^{-1} (pre) *fb*imazethepyr 100 g ha^{-1} (post) produced fruits with increased fruit length.

Pendimethalin (pre) 1000 g ha^{-1} *fb* hand weeding (30 DAS) and pendimethalin (pre) 1500 g ha^{-1} alone had more number of fruits/plant than other treatments. Pendimethalin 1000 g ha^{-1} (pre) *fb* hand weeding (30 DAS), hand weeding twice (30 and 45 DAS), pendimethalin 1500 g ha^{-1} (pre) alone, pendimethalin

1000 g ha^{-1} (pre) *fb*imazethapyr 100 g ha^{-1} (post) and imazethapyr 100 g ha^{-1} (pre) *fb*imazethapyr 100 g ha^{-1} (post) gave significantly higher fruit weight over weedy check. Pendimethalin 1000 g ha^{-1} (pre) *fb* hand weeding (30 DAS), hand weeding twice (30 and 45 DAS), imazethapyr + imazamox 60 g ha^{-1} (post) had more number of nodes/plant than other treatments. Pendimethalin 1000 g ha^{-1} (pre) *fb* hand weeding (30 DAS) being comparable to pendimethalin 1500 g ha^{-1} (pre) alone, pendimethalin 1000 g ha^{-1} (pre) *fb*imazethapyr 100 g ha^{-1} (post) and imazethapyr + pendimethalin 1500 g ha^{-1} (pre) had more inter nodal length than other treatments.

Pendimethalin 1000 g ha^{-1} (pre) *fb* hand weeding (30 DAS) remaining at par with imazethapyr + pendimethalin 1200 g ha^{-1} (pre) and pendimethalin 1500 g ha^{-1} (pre) alone resulted in significantly higher fresh fruit yield/plant and fruit yield per hectare over the other weed control treatments. The treatment, pendimethalin 1000 g ha^{-1} (pre-emergence) *fb* hand weeding remaining at par with imazetapyr + pendimethalin 1200 g ha^{-1} (pre-emergence) and pendimethalin 1500 g ha^{-1} (pre-emergence) resulted in significantly higher fresh fruit yield per plant over other weed control treatments. The fresh fruit yield per plant under weedy check was only 18% of that under pendimethalin 1000 g ha^{-1} (pre-emergence) *fb* hand weeding indicating the importance of weed control in okra. The results are in conformity with the findings of earlier researchers (Kumar *et al.* 2011; Sah *et al*., 2018). Thus, it is very clear that crop needs to be kept weed free at least during the early stages of crop growth until the critical period is over. However, if possible prevalent weeds must be removed before they flower and form seeds otherwise they will be the future threats as 'one year seeding leads to seven years weeding'.

The findings of the study clearly conclude that the ready mix combination of herbicides *viz*. imazethapyr + pendimethalin (pre) 1200 g ha^{-1} is the better option being comparable to pendimethalin 1500 g ha^{-1} and pendimethalin 1000 g ha^{-1} *fb* hand weeding for the control of mixed weed flora and fruit yield of okra.

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